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(71) Applicant: CIENA CORPORATION [US/US]; Legal Department, 1201 Winterson Road, Linthicum, MD 21090 (US).

(72) Inventors: MUSETTI, Robert; 20916 Alves Drive, Cupertino, CA 95014 (US). MIHN-THANH, T., Vo; 2824 Abbey Street, Oakland, CA 94619 (US). ERWIN, Charles, M.; 5587 Marquette Drive, San Jose, CA 95118 (US).

(74) Agent: CAMMARATA, Michael, R.; Ciena Corporation, Legal Department, 1201 Winterson Road, Linthicum, MD 21090 (US).

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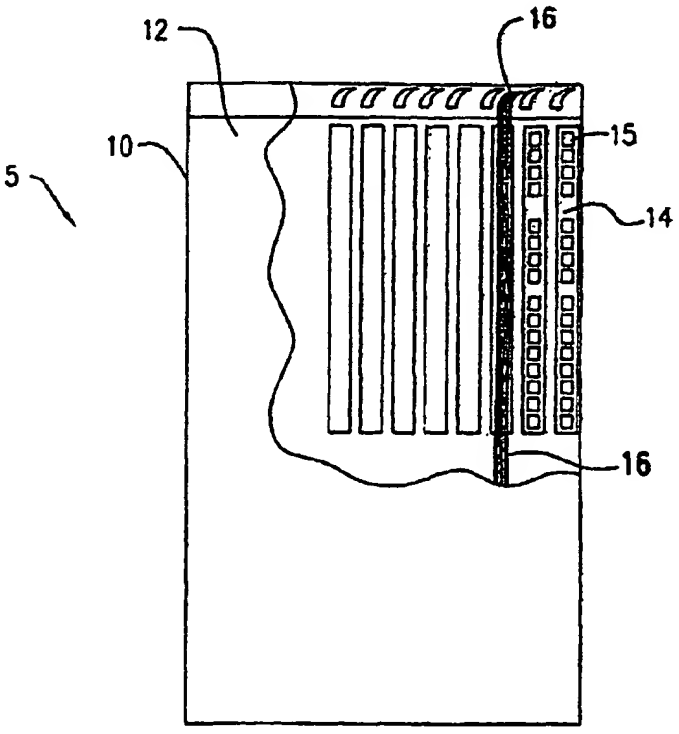
(54) Title: BLANK MODULE WITH CONDUIT RECEPTACLE FOR A COMMUNICATION DEVICE



(57) Abstract: A blank module for a communications system such as an optical networking device is provided. A base is adapted to fit within a space in the communications system reserved for a working module such as an optical line module. At least one conduit receptacle is disposable on the base and capable of retaining a communications conduit at a predetermined length so as to be connectable to a component of the working module that replaces the blank module in the communications system. In this way, any conduits that are not being used at a given time owing to the absence of a working module are sized accordingly and will not have to be lengthened, shortened, or replaced when the actual working module is installed. The conduit receptacle can be used in a working module to substitute for an electrical connector.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BLANK MODULE WITH CONDUIT RECEPTACLE FOR A COMMUNICATION DEVICE

RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Patent Application No. 09/915,405 entitled Blank Module with Conduit Retainer, filed July 27, 2001, internal docket number 407, and incorporates by reference all of the teachings therein.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to the communications field and more particularly to a blank module with conduit or cable place-holding and length-determining features.

Description of the Related Art

Presently, it is a problem in the field of communication cable installation to insure the precise placement of the communication cable without the possibility of damage or performance degradation to the communication cable by the provision of tight bends, or inappropriate use of fasteners, or inadequate support to the communication cable. Such communication cables include conventional telephone cable having a plurality of copper conductors, coaxial cable, optical fiber, or the like. In all of these applications, the minimum radius of curvature of the communication cable is well defined, and bending the communication cable in a tighter bend can cause damage to the communication medium housed within the cable. The installer of communication cable is thus faced with the problem of routing the communication cable over surfaces, which typically includes sharp bends,

without over bending the communication cable, yet also securing the communication cable to these surfaces in a manner to ensure protection from damage.

This problem is further heightened when fiber optic cables are used. Glass fibers used in such cables are easily damaged when bent too sharply and require observation of a minimum bend radius to operate within required performance specifications. The minimum bend radius of a fiber optic cable depends upon a variety of factors, including the signal handled by the fiber optic cable, the style of the fiber optic cable, and equipment to which fiber optic cable is connected.

Inappropriately routed and damaged fiber optic cables may lead to a reduction in the signal transmission quality of the cables. Accordingly, fiber optic cables are evaluated to determine their minimum bend radius. As long as a fiber optic cable is bent at a radius that is equal to or greater than the minimum bend radius, there should be no reduction in the transmission quality of the cable. If a fiber optic cable is bent at a radius below the minimum bend radius determined for such cable, there is a potential for a reduction in signal transmission quality through the bend. The greater a fiber optic cable is bent below its minimum bend radius, the greater the potential for breaking the fiber(s) contained in the cable.

Optical communication equipment is typically housed in bays, which include a rectangular frame having dimensions conforming to a particular standard, such as the Network Equipment Building Standard (NEBS). NEBS was originally developed by Bell Telephone Laboratories in the 1970s and expanded by Bellcore. Long a requirement for equipment used in the Central Office in the North American Public Switched Network, the NEBS criteria have become a universal measure of network product excellence.

An optical communications equipment frame typically has a plurality of shelves, each having one or more slots for accommodating circuit boards or cards that have optical and

electrical components associated with a communication network mounted thereon. The components include, but are not necessarily limited to lasers, photodetectors, optical amplifiers, switching elements, add/drop multiplexers etc. In addition, fiber optic cables typically connect to one or more components. A typical optical networking device is shown schematically in Fig. 1 and will be described below.

One type of component used in optical communications equipment is a line module. A line module typically accommodates a circuit board or card, and a plurality of optical modules that have optical and electrical components mounted thereon. The line module has an opening for receiving the optical modules so that they may interconnect with the circuit board or card provided on the line module. A line module may also have components, normally contained on the optical modules, integrated directly into the line module. A typical line module is shown in Fig. 2 and will be described below.

Ideally, each shelf of an optical communications equipment frame will be fully populated with line modules, and each line module will be fully populated with optical modules. However, the slots of each shelf typically are not fully populated, thereby resulting in the use of blank (dummy) line modules (alternatively called line module blanks or blank modules) as well as with the use of blank (dummy) optical modules (alternatively called optical module blanks). Such blank modules are structurally configured the same way as functional or working modules, which contain electrical components, but specifically do not contain the typical electrical components found within the working modules. These blank modules typically are used due to the equipment requirements of the user or the desire of the user is to leave room for future expansion of the communications system.

It also may be desirable to route all of the optical fibers (alternatively called fiber optic cables) to be used in a fully-populated communications equipment frame, even if line module blanks or partially populated line modules with optical module blanks are used, to

thereby prevent over-handling and potentially damaging the fiber optic cables. Routing all of the fiber optic cables from the beginning also insures that the cables will already be available when blank modules are replaced with true modules.

Currently in the installation process one of two events may occur: either the fiber optic cables are not provided for the unused port spaces in optical module blanks and line module blanks, or all the fiber optic cables are provided and the unused fiber optic cables are left to hang within the equipment frame. If the cables are not provided, then they need to be routed as additional components are installed in the equipment frame, increasing the potential damage that may be caused by over-handling already-installed fiber optic cables. If the fiber optic cables are all provided initially and the unused fiber optic cables are left hanging in the equipment frame they may be damaged when line modules are moved in and out of adjacent slots in the equipment frame, or when the door to the equipment is opened or closed. More importantly, the installer needs to be able to verify that the fiber optic cables that are installed are of adequate length to reach the ports when optical modules or working line modules are added. If they are too long, they will droop down when connected to the optical modules and will be subject to damage whenever the door to the device is opened or adjacent modules are serviced. Slack optical fibers can be subject to vibration (owing, in part, to ventilating air being blown through the device) that can have an adverse effect on signal transmission. If the optical fibers are too short, they will be installed too tautly, and the minimum recommended bend radius would be violated. Alternatively, if the cables are significantly too short, they might not reach the correct optical modules at all.

The same holds true when other optical or electrical conduits are used. For example, during installation of electrical conduits, such as telephone cable having a plurality of copper conductors, coaxial cable, or the like, one of the two events discussed above may occur. As

used herein, the term "conduit" refers to any electrical, optical, or other like media used to transmit and receive data or information from one point to another.

Thus, there is a need in the art to provide an inexpensive means for retaining conduits within a communications system to permit an installer to route all of the desired conduits for a communications frame, to verify the conduits are routed to the correct length and to prevent the conduits from being damaged while they are stored within the frame.

SUMMARY OF THE INVENTION

The invention includes a blank module for a communications system such as an optical networking device. A base is adapted to fit within a space in the communications system reserved for a working module such as an optical line module. At least one conduit receptacle is disposable on the base and capable of retaining a communications conduit such as an optical fiber at a predetermined length so as to be connectable to a component of the working module that replaces the blank module in the communications system. Any conduits that are not being used at a given time owing to the absence of a functional working module are sized accordingly and will not have to be lengthened, shortened, or replaced when the actual working module is installed. The conduit receptacle may be used in a working line module to substitute for missing electrical connectors.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an overall schematic of an embodiment of a communications networking device to which the invention is applicable.

Fig. 2 is a perspective view of an embodiment of a line module component of the communications device of Fig. 1.

Figs. 3A-B are front perspective views of a blank module in accordance with an embodiment of the invention.

Figs. 4A-E are perspective views of a conduit receptacle in accordance with an embodiment of the invention.

Fig. 5A is a top plan view of the conduit receptacle of Fig. 4.

Fig. 5B is a side plan view of the conduit receptacle of Fig. 4.

Fig. 6 is a front plan view of the conduit receptacle of Figs. 4 and 5.

Figs. 7A is a top sectional view taken along line 7A—7A of Fig. 6.

Figs. 7B is a top sectional view taken along line 7B—7B of Fig. 6.

Fig. 8 is a schematic of a slot in the faceplate of the blank module of Fig. 3.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Description of embodiments of the invention will now be given with reference to the attached Figs. 1-8. These drawings are merely exemplary in nature and in no way limit the scope of the invention, which is defined by the claims appearing hereinbelow.

Fig. 1 depicts a schematic of a typical networking device 5 usable in a communication network. For simplicity purposes, reference to a telecommunication network, data communication network or a communication network each shall be viewed as encompassing the meaning associated with all of three of these terms. Device 5 includes a chassis 10 that has an openable door 12 shown in broken view. Within the chassis is disposed some support structure (not shown) such as shelving, hooks, etc., for supporting a series of circuit boards or line modules 14. Fig. 2 shows in perspective a typical line module 14, in this case an LM-16 or 16-port line module (each port has two fiber connections, one for input and the other for output). It is provided with a number of female LC connectors 15 protruding through the faceplate 14A of the line module. Each LC connector 15 has two

recesses, each one adapted to receive one optical fiber 16 having a corresponding male LC connector at its end. Each LC connector 15 is respectively connected to an optical transceiver 19. Line module ("LM") 14 also includes one or more retaining levers 17 which secure the line module inside chassis 10 of networking device 5.

Turning now to Fig. 3, the dummy or blank module 24 of an LM-16 is shown in detail. Blank module 24 includes a faceplate 24A and a substantially planar main section 24B. It is provided with a number of conduit receptacles 25, which take the place of LC connectors 15, mounted in slots 24C formed in faceplate 24A of the blank module 24. Each conduit receptacle 25 has two recesses, each one adapted to receive one optical fiber 16 having a corresponding male LC connector at its end. Unlike the LC connectors 15 of Fig. 2, conduit receptacles 25 are not connected to any optical or electronic components but rather terminate in a flat wall, as will be described below. Blank module 24 also includes one or more retaining levers 27 which secure the line module inside chassis 10 of networking device 5, as well as backplane attachment means 28 for securely connecting the blank module to the backplane of device 5 in a known manner.

Embodiments of the inventive conduit receptacle 25 are shown in detail in Figs. 4-7. Receptacle 25 is shown having a main body 30 with two recesses 32. Each recess 32 is configured and shaped to receive one optical fiber having an LC connector at its end. At the rear portion of recess 32 is rear wall 33. Unlike a conventional female LC connector, which is required to align the male LC connector of an optical fiber precisely with an optical component, conduit receptacles 25 are not for data transmission. Rather, conduit receptacles 25 serve as placeholders for optical fibers in blank module 24. Blank module 24 is configured and shaped to resemble a working module 14 (i.e., one having the appropriate electronic components), and the slots 24C in faceplate 24A are positioned to correspond with LC connectors 15 of a line module 14. As a result, any optical fibers that are measured out to

connect to a given conduit receptacle 25 will also be the precise length to connect to a corresponding LC connector 15 on a working line module 14 when the blank module 24 is removed and the working line module is installed. In this way, the optical fibers 16 undergo significantly less handling and are thus less susceptible to damage. Also, the optical fibers are assured to be the precise length to connect to their respective LC connectors 15 so that the fibers need not be shortened, lengthened, or replaced when a working module 14 is inserted into a networking device 5.

Conduit receptacle 25 is designed to be snap-fitted into slots 24C of blank module 24. As such, receptacle 25 includes at least one locking tab 36 extending from main body 30 along the side thereof and a stopping plate 34, which surrounds the perimeter or circumference of main body 30. When the receptacle 25 is inserted into slot 24C, locking tab 36 engages the rear portion of the faceplate 24A and prevents receptacle 25 from falling out of the front of the faceplate 24A. Stopping plate 34 prevents receptacle 25 from being inserted too far through slot 24C and/or falling out of the rear of faceplate 24A. As best shown in Fig. 7A, a gap 37 is formed between locking tab 36 and stopping plate 34; it is in gap 37 that the rim of faceplate 24A surrounding slot 24C is captured.

As shown in Figs. 5 and 7A, it is preferred (though not required) to provide two locking tabs 36 on opposite sides of main body 30. In the preferred embodiment, locking tab 36 is attached to main body at a fixed end 36A and has a free opposite end 36B. This cantilever leaf spring design enables locking tab to flex when receptacle 25 is inserted into slot 24C and then snap back into position to engage the rim of the faceplate 24A in gap 37. Alternatively, the locking tab need not be cantilevered but could instead be attached at both ends with a bulging central portion that would flex inwardly closer to the main body 30 when insertion occurs.

It is desirable to insure that the conduit receptacles 25 are always and consistently inserted into slots 24C in the same orientation. As such, conduit receptacle 25 is provided with a projection 38 that is preferably asymmetrically disposed on main body 30. Correspondingly, as shown in Fig. 8, slot 24C of faceplate 24A is provided with a cutout 29, which is shaped to receive and matingly accommodate projection 38. In this way, receptacle 25 can only be inserted into slot 24C in one orientation, the orientation in which projection 38 aligns with cutout 29. Alternatively, the slot may be provided with a projection and the receptacle be provided with a mating recess or cutout. The important aspect is that the conduit receptacle and its slot are keyed to prevent insertion of the receptacle in any orientation except the one preferred orientation.

As shown in Figs. 7A-B, the conduit receptacle 25 is made of plastic. Preferably, the material used is V0 fire-resistant and is more preferably like polycarbonate. An example of a particularly well-suited material out of which to make conduit receptacle 25 is Lexan. The conduit receptacle 25 is also preferably made as one piece. This is advantageous over conventional electrical connectors, which typically require either metal bands for the locking pieces, metal contacts to conduct electricity, or both. Hence, the inventive conduit receptacle 25 is less expensive and easier to manufacture.

The embodiments of the invention are not limited to what is shown in the drawings or described above. For example, the conduits are shown to be optical fibers, but an alternative embodiment of the invention is applicable to any type of data transmission line used in communications, for example copper conductors, coaxial cable, or any other type of electrical or optical conductors. The receptacle is shown to accommodate LC connectors, however embodiments of the invention are not limited to LC connectors but rather contemplate all types of connectors. The embodiment shown has two recesses per receptacle as a duplex optical fiber, however the inventive conduit receptacle may have as few as one

recess or as many recesses as is practical for this application. Also, any number of locking tabs may be provided on each receptacle. Similarly, any number of keyed projections or indentations may be provided to correspond with mating indentations or projections in the slots of the faceplate. Embodiments of the conduit receptacles are shown in conjunction with the inventive blank module, however the inventive conduit receptacles may also be used in working line modules to fill in the gaps where an electronic component is not provided or available. If so used, then the keyed projection might not be employed because conventional line modules presently do not have keyed slots. If future line modules are provided with keyed slots, the inventive conduit receptacle may also be so provided.

What is claimed is:

1. A blank module for a communications system, comprising:

a base adapted to fit within a space in the communications system reserved for a working module; and

at least one conduit receptacle disposable on said base and capable of retaining a communications conduit,

wherein the conduit is retained at a predetermined length so as to be connectable to a component of the working module that replaces the blank module in the communications system.

2. A blank module for a communications system according to Claim 1, said base further comprising at least one slot, and said conduit receptacle being lockingly disposable in said slot.

3. A blank module for a communications system according to Claim 2, said conduit receptacle comprising at least one recess adapted to receive an end of the conduit.

4. A blank module for a communications system according to Claim 3, said recess being adapted to receive an LC connector of an optical fiber.

5. A blank module for a communications system according to Claim 2, said conduit receptacle further comprising:

a main body fittable into said slot on said base; and

at least one flexible locking tab extending from said main body,

wherein when said conduit receptacle is inserted into said slot, said locking tab passes through said slot and engages a rear surface of said base near said slot.

6. A blank module for a communications system according to Claim 5, wherein said locking tab is integral with and extends from said main body as a leaf spring.

7. A blank module for a communications system according to Claim 6, wherein said locking tab extends from said main body in a cantilever manner.

8. A blank module for a communications system according to Claim 5, said conduit receptacle further comprising a stopping plate extending circumferentially around at least a portion of said main body, said stopping plate being larger than said slot,

wherein when said conduit receptacle is inserted into said slot, said stopping plate prevents said conduit receptacle from being inserted beyond a predetermined point.

9. A blank module for a communications system according to Claim 8, wherein when said conduit receptacle is inserted into said slot, a rim of said slot is captured between said locking tab and said stopping plate.

10. A blank module for a communications system according to Claim 2, said slot being positioned on said base to correspond with an electrical connector on the working module.

11. A blank module for a communications system according to Claim 1, said base comprising:

a faceplate upon which said slot is formed; and

a main section dimensioned to emulate the working module.

12. A blank module for a communications system according to Claim 11, wherein the blank module comprises a line module blank to hold the place of a working line module.

13. A blank module for a communications system according to Claim 12, wherein the communications system is an optical networking device and the conduit is fiber optic cable.

14. A blank module for a communications system according to Claim 5, further comprising:

at least one asymmetric cutout formed on one of said slot and said main body of said conduit receptacle; and

at least one asymmetric projection formed on the other of said slot and said conduit receptacle corresponding to said cutout,

wherein because said conduit receptacle can only be inserted into said slot in one orientation.

15. A blank module for a communications system according to Claim 1, wherein said at least one conduit receptacle comprises a plurality of conduit receptacles for retaining a plurality of conduits at respective predetermined lengths that correspond to the respective lengths of conduits that connects with a component of the working module that replaces the blank module in the communications system.

16. A conduit receptacle for substituting for an electrical connector in a communications system, capable of retaining a communications conduit and disposable in a slot of a module of the communications system, comprising:

a main body fittable into a slot on a base of the module;

at least one recess formed in said main body adapted to receive an end of the conduit; and

at least one flexible locking tab extending from said main body,

wherein when said conduit receptacle is inserted into the slot, said locking tab passes through the slot and engages a rear surface of the base near the slot.

17. A conduit receptacle according to Claim 16, said recess being adapted to receive an LC connector of an optical fiber.

18. A conduit receptacle according to Claim 16, wherein said locking tab is integral with and extends from said main body as a leaf spring.

19. A conduit receptacle according to Claim 18, wherein said locking tab extends from said main body in a cantilever manner.

20. A conduit receptacle according to Claim 16, said conduit receptacle further comprising a stopping plate extending circumferentially around at least a portion of said main body, said stopping plate being larger than the slot,

wherein when said conduit receptacle is inserted into the slot, said stopping plate prevents said conduit receptacle from being inserted beyond a predetermined point.

21. A conduit receptacle according to Claim 20, wherein when said conduit receptacle is inserted into the slot, a rim of the slot is captured between said locking tab and said stopping plate.

22. A conduit receptacle according to Claim 16, further comprising:

at least one asymmetric projection formed on said conduit receptacle corresponding to an cutout formed in the slot,

wherein said conduit receptacle can only be inserted into the slot in one orientation.

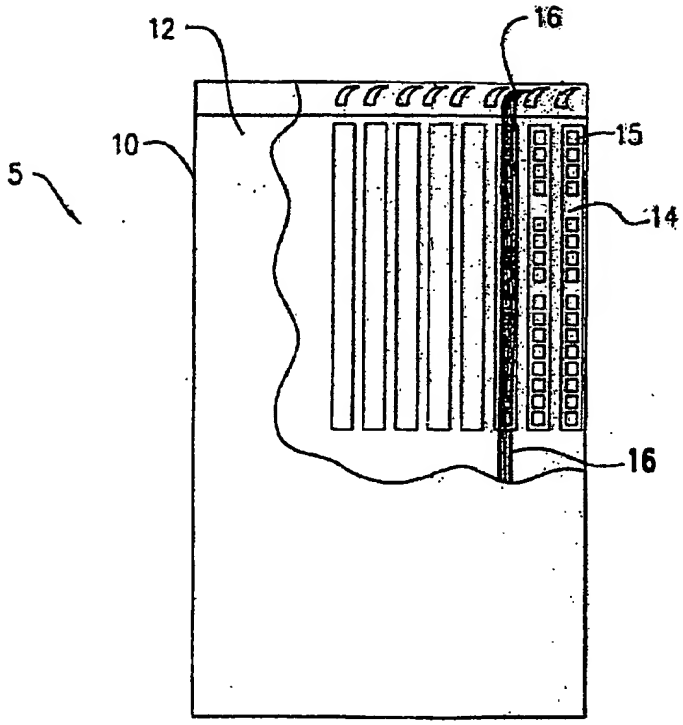

FIG. 1

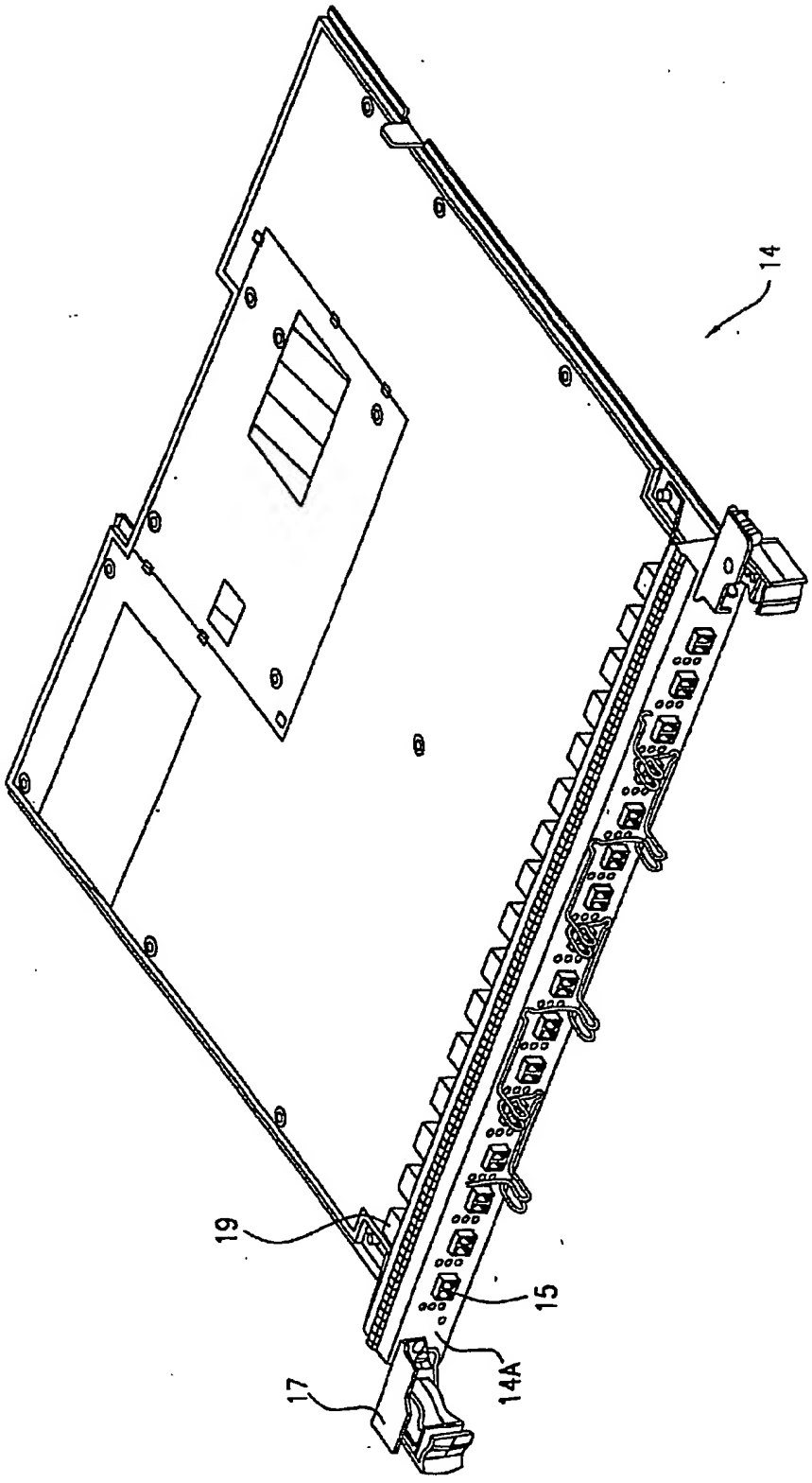

FIG. 2

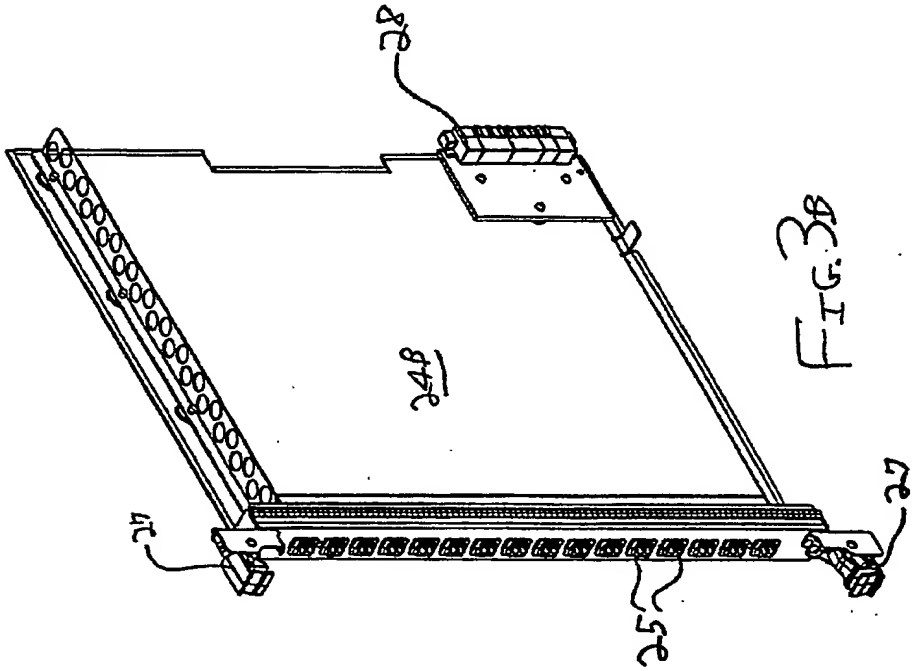

FIG. 3B

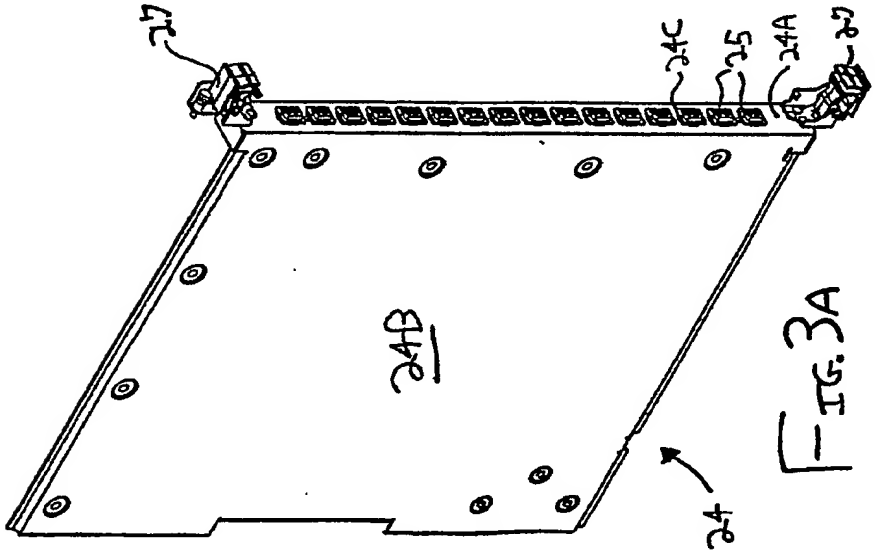

FIG. 3A

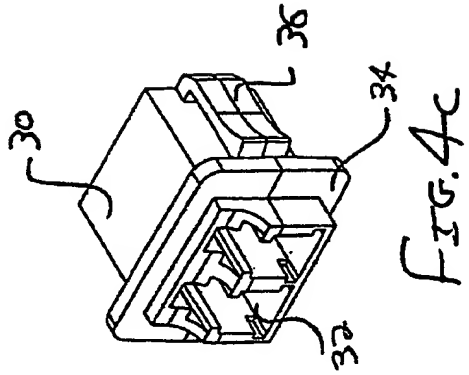

FIG. 4C

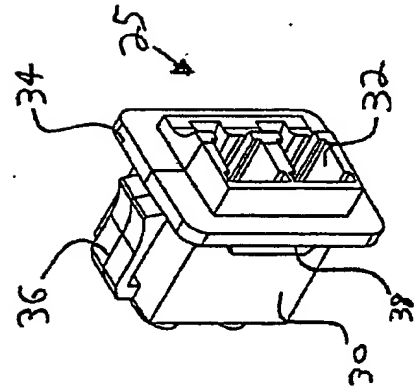

FIG. 4B

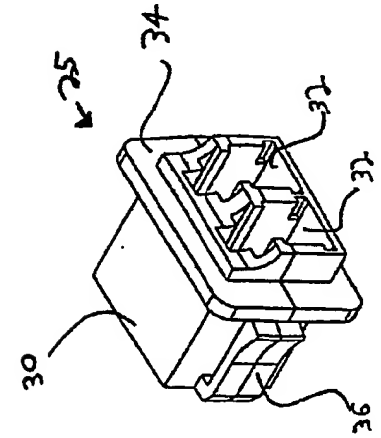

FIG. 4A

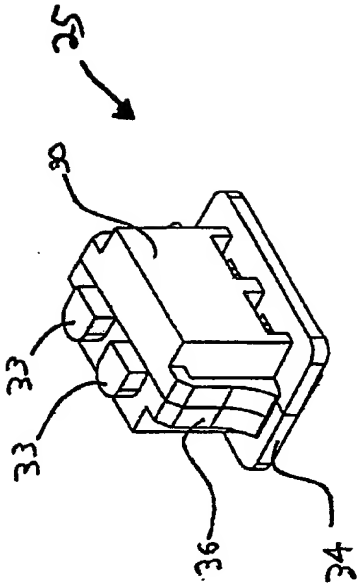

FIG. 4E

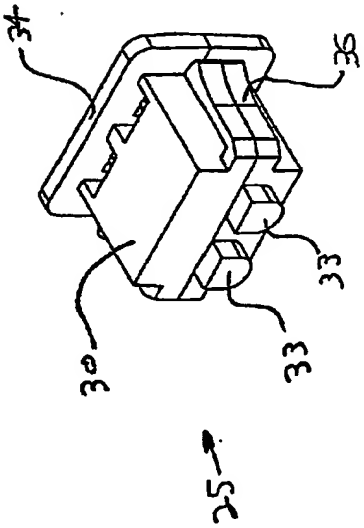

FIG. 4D

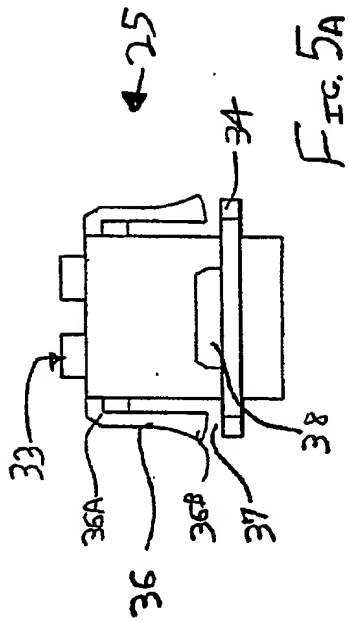

FIG. 5A

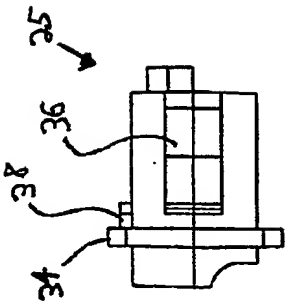

FIG. 5B

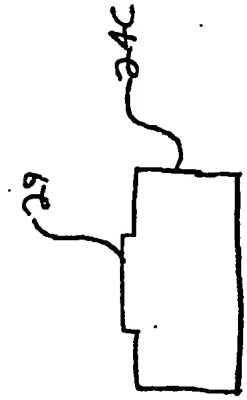

FIG. 8

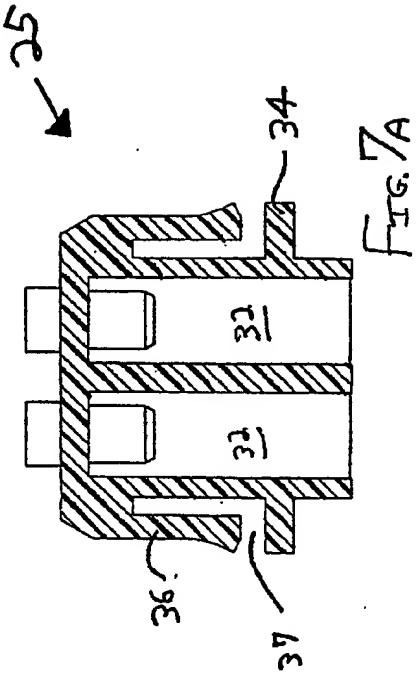

FIG. 7A

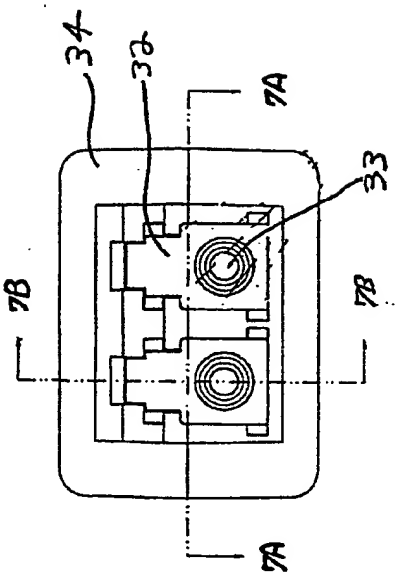

FIG. 6

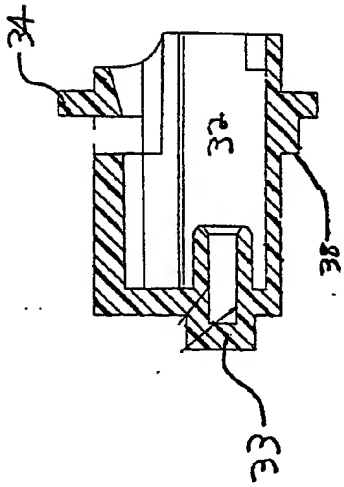

FIG. 7B

US005271152A

United States Patent [19]

Murphy

[11] Patent Number: 5,271,152

[45] Date of Patent: Dec. 21, 1993

[54] **PROCESS FOR MAKING A COMPUTER TOWER CHASSIS USING MODULES**

[75] Inventor: **Preston J. Murphy**, Austin, Tex.

[73] Assignee: **Compuadd Corporation**, Austin, Tex.

[21] Appl. No.: **883,587**

[22] Filed: **May 13, 1992**

Related U.S. Application Data

[62] Division of Ser. No. 623,589, Dec. 7, 1990, Pat. No. 5,159,528.

[51] **Int. Cl.**[5] **H05K 3/36**

[52] **U.S. Cl.** **29/830**; 29/832

[58] **Field of Search** 29/830, 832; 361/380, 361/390-392

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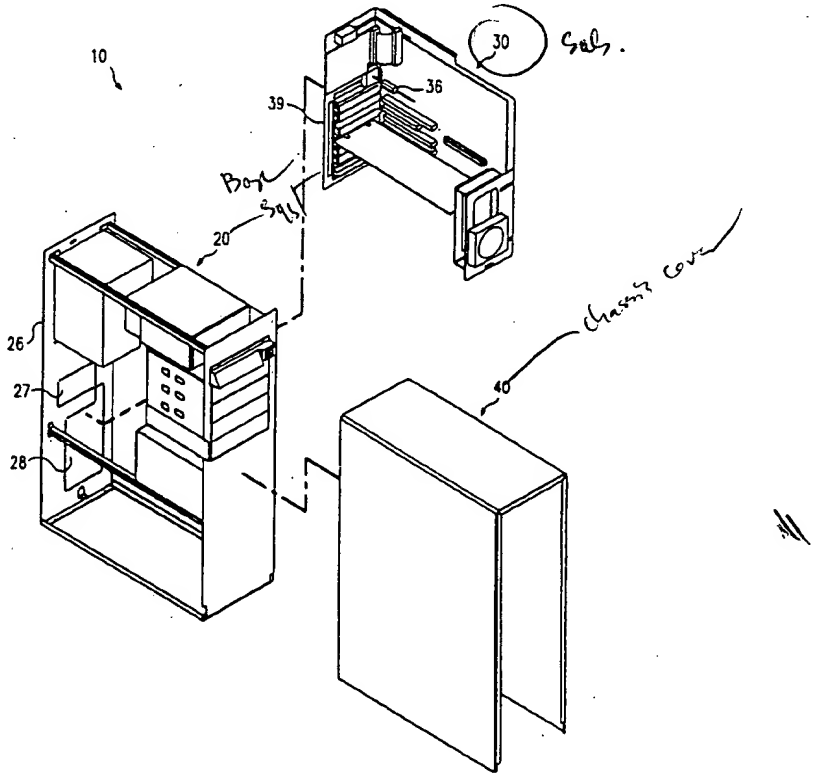
Primary Examiner—Mark Rosenbaum
Assistant Examiner—Kenneth S. Hansen
Attorney, Agent, or Firm—Baker & Botts

[57] **ABSTRACT**

A computer tower chassis (10) has a base system unit (20) and a main circuit board subassembly (30). The base system unit (20) includes base system frame (200) having a front panel (21) and rear panel (26) and supporting frame (201, 202, 203, 204, and 205) therebetween. Disk (22), control panel (23), power supply (24), and floppy drives (29) mount to the base system unit (20). The main circuit board subassembly (30) includes main circuit board (31), input/output board and cable (32), speaker and cable (33), fan assembly and cable (35), keyboard cable (36), expansion card (37) and expansion card guides (38) and (39). Main circuit board subassembly (30) fits within and adjacent to base system unit (20), with chassis cover (40) surrounding both modules. The modular design allows for safer and more efficient manufacturing and handling.

1 Claim, 4 Drawing Sheets



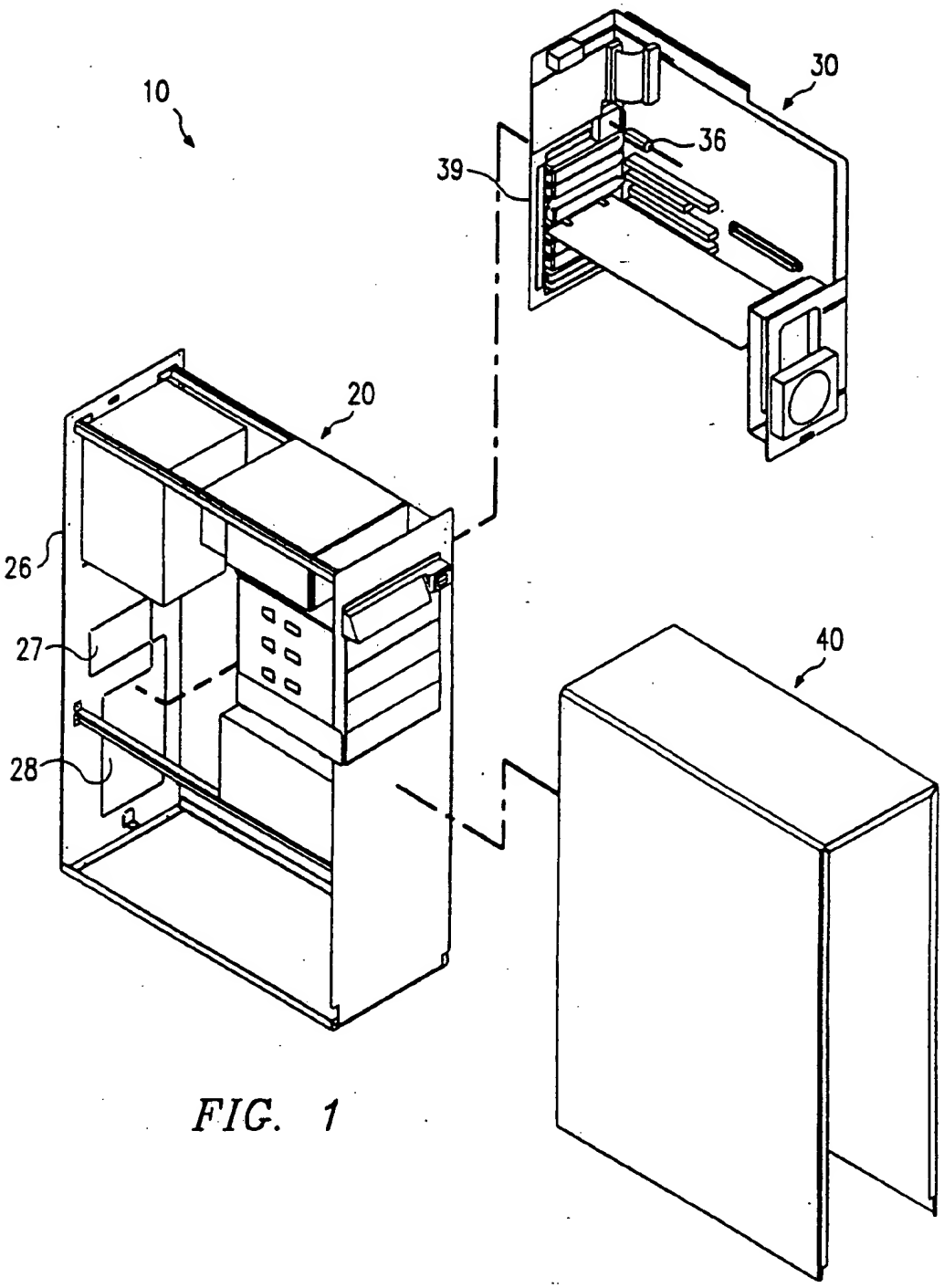
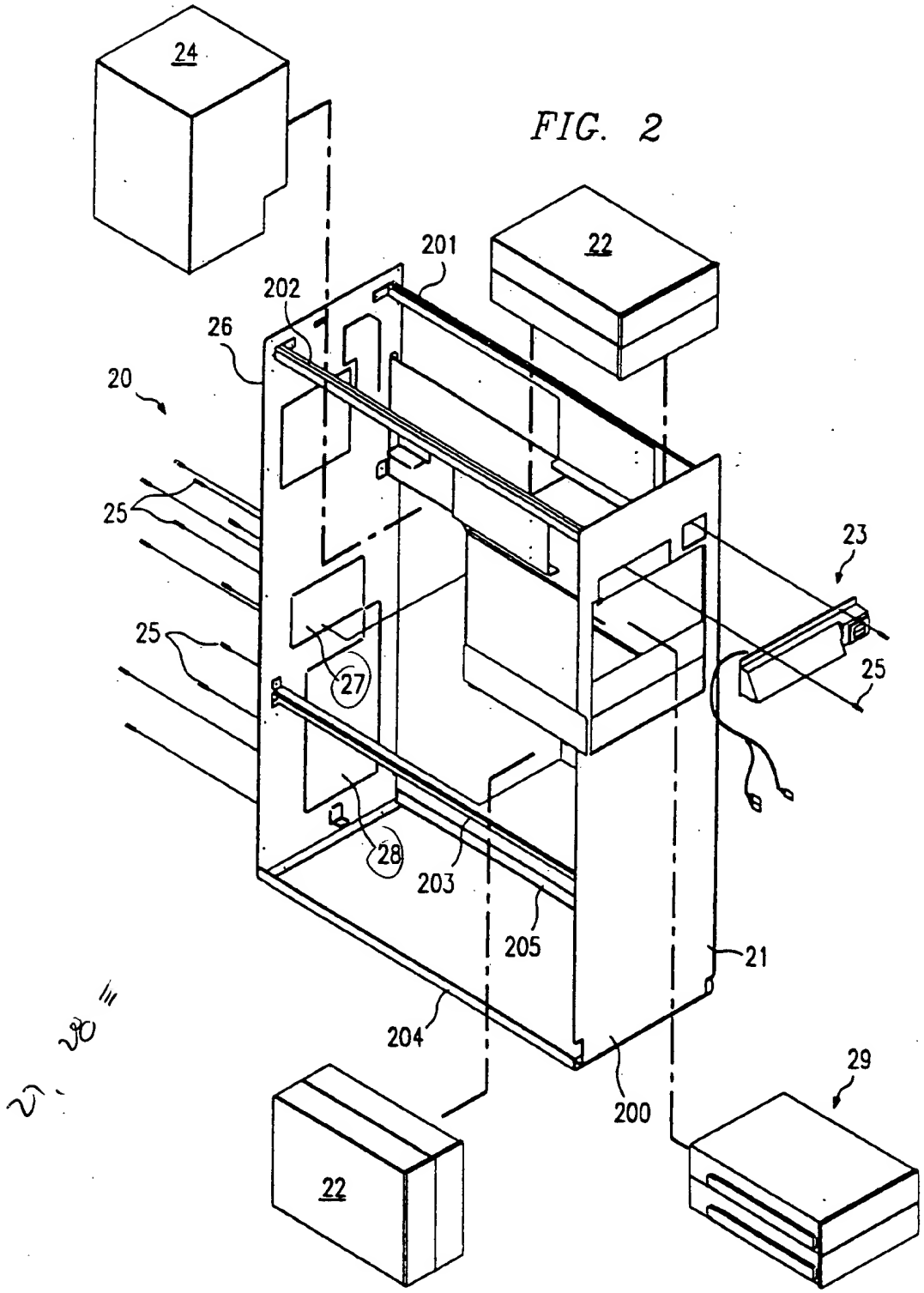


FIG. 1

FIG. 2



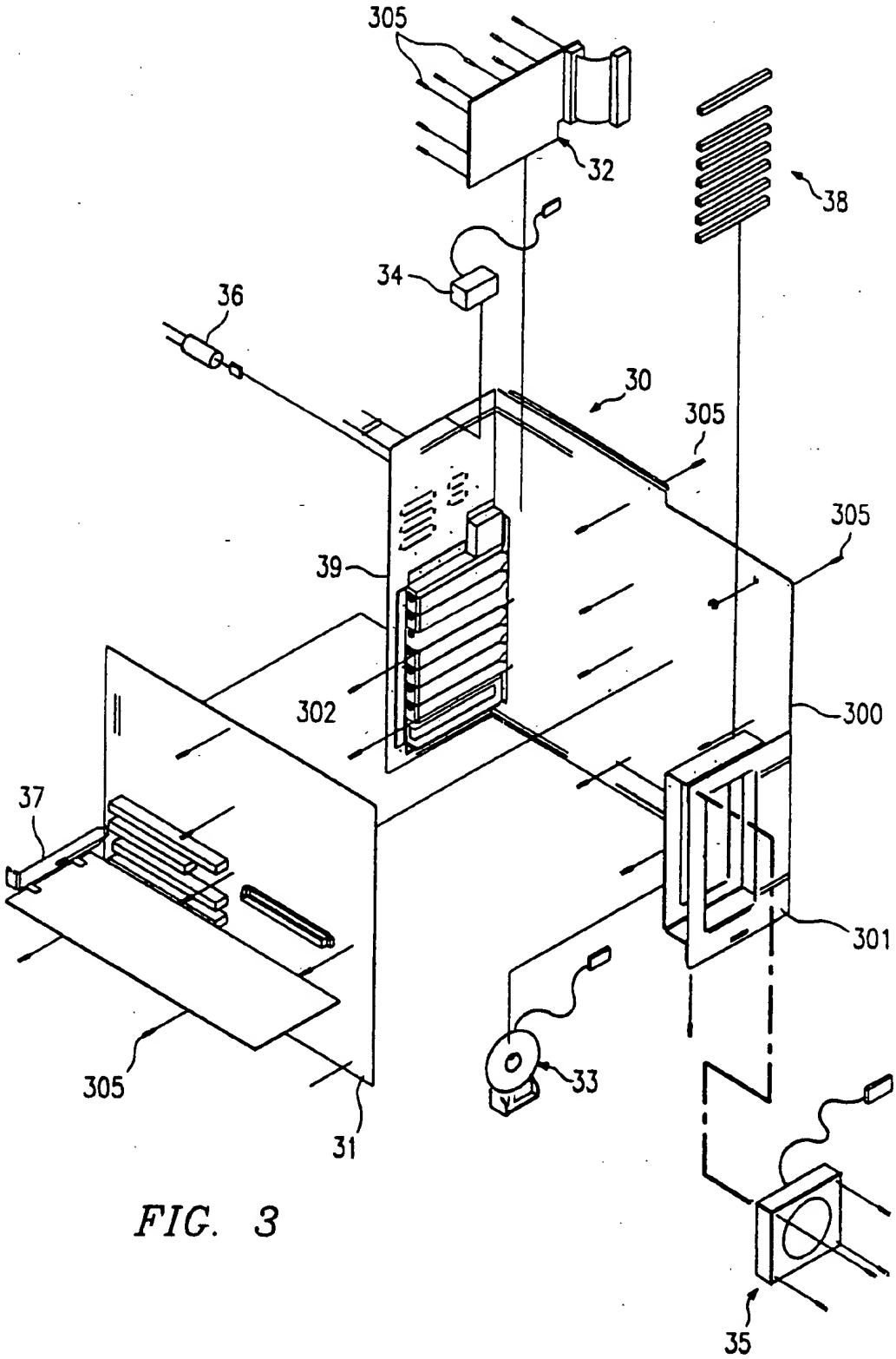


FIG. 3

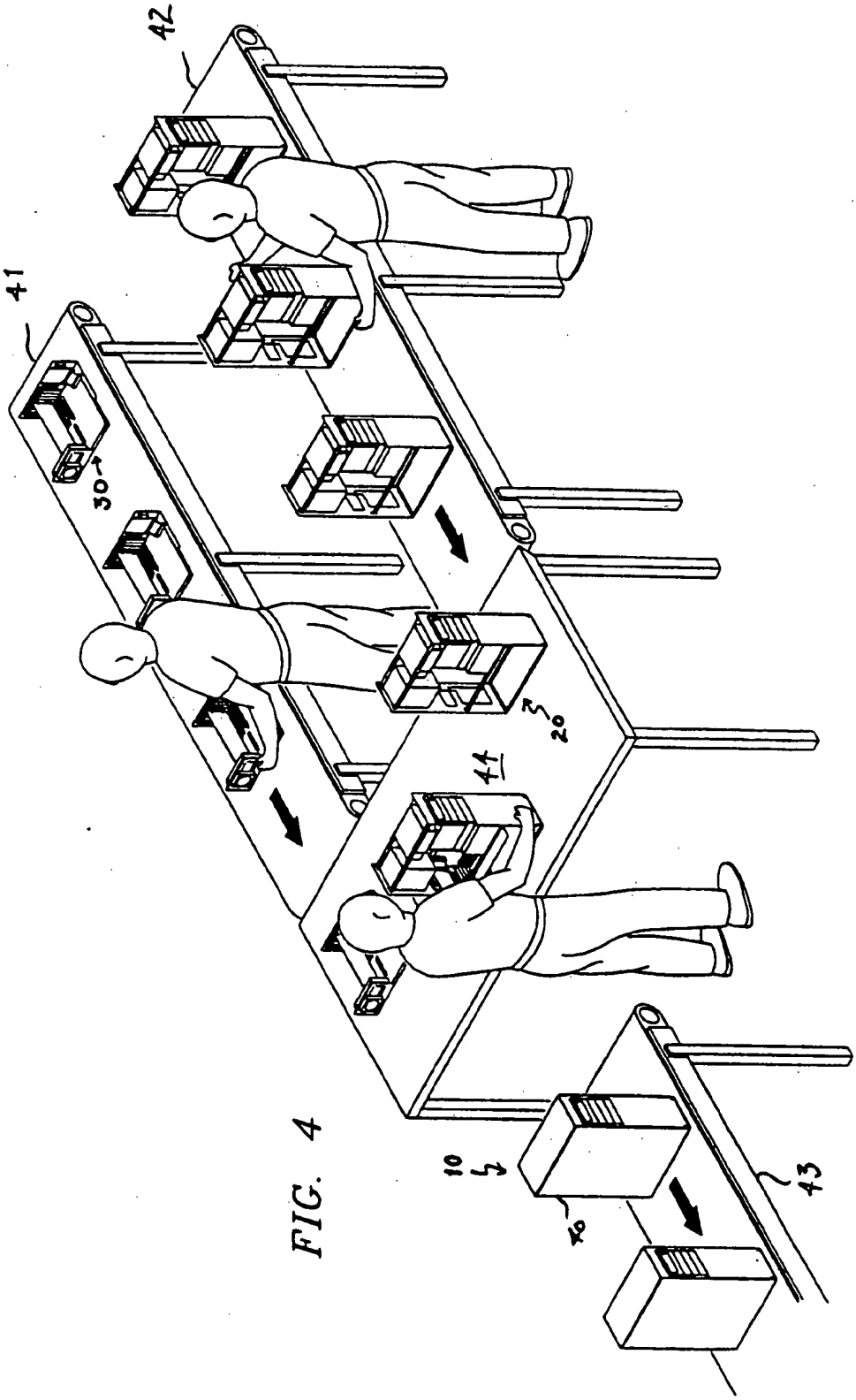


FIG. 4

PROCESS FOR MAKING A COMPUTER TOWER CHASSIS USING MODULES

This application is a divisional of application Ser. No. 07/623,589, filed Dec. 7, 1990 and entitled "Modular Personal Computer," now U.S. Pat. No. 5,159,528, issued Oct. 27, 1992.

TECHNICAL FIELD OF THE INVENTION

This invention relates to a method and apparatus for a manufacturer to assemble electronic hardware for an electronic system and more particularly to a method and system for assembling a computer tower chassis.

BACKGROUND OF THE INVENTION

Computer systems, particularly personal computer systems, include a box or chassis that contains the electronic hardware of the central processing unit and communication cables for transferring data between terminals and other data communications components. Typically, the manufacture of the chassis includes forming a metal support frame to receive the electronic hardware and placing a cover around the electronic components and the support frame. Although a personal computer chassis is sufficiently small that one person usually can pick it up, a fully assembled unit weighs approximately 70 pounds.

As factory assembly of a personal computer chassis takes place, the chassis increases in weight and becomes more difficult to maneuver along an assembly line. Picking up and moving the heavy computer chassis can present safety and handling problems for factory workers. If a method and apparatus existed to preassemble major portions of the computer chassis prior to full assembly of the chassis itself, the weight of the chassis could be distributed among the major modular portions. This would eliminate problems associated with moving and handling the complete tower chassis until final assembly.

A fully assembled tower chassis includes a main circuit board that comprises a central processing unit and other communications and data processing electronic components as well as power conversion and distribution components that operate the computer. If it were possible to separate a significant portion of the tower chassis electronic components in a modular fashion to concentrate repair efforts on a major modular section, handling safety problems associated with these repairs would also be minimized.

Related problems exist with respect to efficiency in manufacturing the computer chassis. For example, known tower chassis assembly methods begin with the chassis structural frame. Throughout the computer assembly, all electronic and mechanical components of the tower chassis are installed on the structural frame. As components on the structural frame become more densely packed together, it becomes increasingly difficult for more than one worker to assemble additional components on the structural frame. As a result, the manufacturing process slows as the tower chassis becomes more densely packed with mechanical and electronic components.

If a system and method existed to allow workers to first assemble major portions of the computer tower chassis and then connect the major portions together, more than one worker could easily assemble the separate major portions. This would increase computer tower assembly rates and ultimately increase the manufacturing process efficiency.

Consequently, there is a need for a method and apparatus that minimizes the safety, handling, and assembly problems associated with manufacturing a computer chassis. There is a need for an apparatus that allows repair personnel to safely and efficiently disassemble a computer tower chassis for the purpose of isolating and repairing defective components of the computer tower chassis.

There is a need for a method and apparatus that allows more than one factory worker to simultaneously assemble portions of a computer tower chassis.

SUMMARY OF THE INVENTION

The present invention provides a computer tower chassis and chassis manufacturing process which overcome the problems and satisfy the needs previously considered. The method and apparatus allow modular assembly of major portions of the computer tower chassis during the manufacturing process, thereby allowing manufacture of major portions of the tower chassis followed by assembly of the major modular portions just prior to final electronic component testing and burn in.

The computer tower chassis of the present invention accomplishes these objectives by separating the tower chassis into a base system unit and a main circuit board subassembly. The base system unit provides the major structure for the tower chassis and includes floppy drives and hard drives, a control panel, a power supply, and appropriate cables. The main circuit board assembly includes the principal electronic components of the computer tower chassis such as the main circuit board itself, the input/output boards and cables, battery pack and cable, speaker assembly and cables, fan assembly and cables and all required expansion boards.

In the manufacture of the computer tower chassis, the base system unit and the main circuit board subassembly can be manufactured at the same time (i.e., in parallel). When the base system unit and main circuit board subassembly are complete, they can be joined together to form a computer tower chassis sufficiently complete for final testing and burn in. Thereafter, the tower chassis cover is placed around the chassis to complete the manufacturing process. The base system unit has a structural frame and support members associated to receive the main circuit board subassembly and to structurally support both the main circuit board subassembly, as well as the components that attach to the base system unit.

If, as a result of testing, one or more components on the base system unit or the main circuit board subassembly are shown to be defective, the defective portion can be promptly replaced by a fully functional modular portion. By swapping out the defective module with a satisfactory one, the assembly process can continue to completion for that particular tower chassis.

Placing the primary electrical and mechanical portions of the tower chassis on the base system unit and the electronic components on the main circuit board subassembly divides the computer tower chassis weight. As a result, until final assembly, the module that a worker handles weighs significantly less than the complete tower chassis. This results in safer and more easily maneuverable components prior to final assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and further advantages thereof, reference is now made to the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 shows an exploded view of the modular tower chassis of the present invention and its associated cover;

FIG. 2 is an exploded perspective of the base support unit of the modular tower chassis of the present invention;

FIG. 3 is an exploded perspective view of the main circuit board subassembly of the present invention; and

FIG. 4 illustrates the relative size of a computer tower chassis as it progresses along an assembly line to show some of the advantages of the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 illustrates the modular design of the present invention. Computer chassis 10 includes the base system unit 20, adjacent to which fits main circuit board subassembly 30. Once base system unit 20 and main circuit board subassembly 30 join to form computer tower chassis 10, cover 40 fits over it to protect computer tower chassis 10. Main circuit board subassembly 30 has keyboard cable 36 and rear expansion card guides 39 which fit through openings 27 and 28 on the rear portion 26 of base system unit 20.

FIG. 2 shows a more detailed and exploded perspective view of base system unit 20 according to the preferred embodiment of the present invention. Base system unit 20 includes support frame 200 which comprises front support plate 21 and rear support plate 26. Between front support plate 21 and rear support plate 26 are structural beams 201, 202, 203, 204 and 205. Within support frame 200 are various components that form base system unit 20. Hard drives 22 and power supply 24 mount within base system unit 20. Attaching to and extending through base system unit 20 are control panel 23 and floppy drives 29. Fasteners 25 securely hold each of these units to base system unit 20 and attach main circuit board subassembly 30 to base system unit 20.

FIG. 3 provides an exploded perspective view of main circuit board subassembly 30 in the preferred embodiment of the present invention. Main circuit board subassembly 30 includes the subassembly plate 300 having integral thereto rear panel 302 and front subassembly panel 301. Front subassembly panel 301 includes the front expansion board guides 38. Rear panel 302 includes rear expansion slots 39. Main circuit board 31 mounts to subassembly plate 300 so that expansion cards 37 may connect within front expansion card guides 38 and rear expansion slots 39. Input/output board and cable 32 mounts to subassembly plate 300. Speaker assembly and cable 33 and fan assembly and cable 35 mount to front subassembly panel 301. Battery pack and cable 34 and keyboard cable 36 mount to and through rear subassembly panel 302. Numerous fasteners 305 secure the above components to main circuit board subassembly plate 300.

In the design of FIGS. 2 and 3, principally mechanical and electrical components attach to base system unit 20. These all attach to the front and rear panels of base system frame 200 in a way that provides sufficient room for subsequent insertion of the completed main circuit board subassembly 30. Main circuit board subassembly 30 has various components that penetrate through base system frame 200 for electrical and electronic external connections. These components include rear expansion slots 39 and keyboard cable 36. Base system frame 200 provides openings 27 and 28 to permit connection to rear expansion slots 39 and keyboard connection 36.

The design of main circuit board subassembly 30 is similar, but not identical to the interior portion of the High Profile chassis manufactured by CompuAdd Corporation of Austin, Tex., stock #15000-3. This is a known configuration for the placement of main circuit board 31 and the associated expansion cards 37 and front expansion card guides 38 and rear expansion slots 39, as well as the other components of main circuit board subassembly 30. The technical advantage associated with this design is that the modular approach to main circuit board subassembly 30 and base system unit 20 can be implemented by factory workers trained to assemble the CompuAdd High Profile chassis and similar designs. As a result, implementing the modular design is possible with minimal additional training of factory workers.

Because the basic system unit and main circuit board subassembly 30 are modular in design, they can be assembled separately until they are finally joined. For example, one assembly line in a factory could assemble base system unit 20, including power supply 24, hard drives 22, floppy drives 29 and control panels 33. Another assembly line in the same or a different factory could assemble main circuit board subassembly 30, including main circuit board 31, input/output board and cable 32, speaker assembly and cable 33, fan assembly and cable 35, input/output board and cable 32, and keyboard cable 36. The result would be a separate base system unit 20 and main circuit board subassembly 30 to join together for final system testing and burn in. Thereafter, cover 40 would be placed on the completed computer tower chassis to make the chassis ready for shipment. With the distributed weight made possible by having one assembly line assemble the system unit 20 and another assembly line assemble the main circuit board subassembly 30, the problems of safely handling a complete computer tower chassis are minimized. Although the weight of the completed computer tower chassis is distributed between base system unit 20 and main circuit board of subassembly 30, the weight would not necessarily be distributed evenly, because the number of hard drive devices in base system unit 20 can vary.

Although it is shown that the base system unit 20 and main circuit board subassembly 30 have a particular set of components that join together in each respective module in the preferred embodiment of the present invention, there may be other combinations of respective components as well as additional components that could be included in each of the assemblies for modular fabrication. In particular, base system unit 20 may include multiple hard drive devices and up to five half height media devices in the preferred embodiment. The four bay external drive holder can, for example, accommodate a floppy drive, a tape backup unit, a CD ROM device, and/or a hard drive. Combinations of these are within the scope of the present invention. Moreover, depending on the size and complexity of the computer tower chassis, it may be advantageous for the chassis to comprise more than two separately assembled modules. Additionally, the main circuit board subassembly 30 of the present invention could use various styles of main

circuit boards and numerous configurations of expansion boards.

The configuration of components that mount to base support frame **200** depends on the design of the computer tower chassis. However, for the purposes of the present invention, the configuration must permit separating and joining of the main circuit board subassembly **30** from base system unit **20**. Additionally, this arrangement of the individual support frames **201, 202, 203, 204** and **205** may be varied according to the particular design requirements of both base system unit **20** and interconnection requirements of main circuit board subassembly **30**. Easy withdrawal of expansion cards **37** from main circuit board subassembly **30**, without the need to disassemble main circuit board subassembly **30** from base system unit **20**, is another design consideration of the present invention. In other words, a modular design of base system unit **20** and main circuit board subassembly **30** need not adversely affect the interchangeability of expansion cards with the main circuit board **31**.

FIG. **4** illustrates an important aspect of the preferred embodiment of the present invention. Along assembly lines **41** and **42** travel main circuit board subassembly **30** and base system unit **20**, respectively. At station **44**, for example, main circuit board subassembly **30** and base system unit **20** may be joined to result (after placement of cover **40**) in completed tower chassis **10**. Tower chassis **10** joining in this manner achieves many of the purposes of the present invention.

Although the invention has been described with reference to the above specific embodiments, this description is not meant to be construed in a limiting sense. Various modifications of the disclosed embodiment, as well as alternative embodiments of the invention will become apparent to persons skilled in the art from reference to the above description. It is further contemplated that the claims will cover such modifications and fall within the true scope of the invention.

What is claimed is:

1. A method of assembling a modular personal computer, comprising:

installing a control panel, a power supply, and at least one disk drive selected from the group of hard drives and floppy drives onto a base system unit including a support frame having a front support plate and a rear support plate, the rear support plate being spaced from the front support plate, at least one structural beam connecting the front support plate to the rear support plate;

removably installing a main circuit board onto a main circuit board assembly including a subassembly plate having front and rear edges, a front subassembly panel having an orifice therethrough attached to the front edge of the subassembly plate, a rear assembly panel having a plurality of orifices therethrough attached to the rear edge of the subassembly plate, at least one front expansion board guide attached to the front subassembly panel, at least one rear expansion slot attached to the rear subassembly panel;

removably connecting at least one expansion card having front and rear ends to the main circuit board whereby the front and rear ends of the expansion cards removably connect to the front expansion board guides and to the rear expansion slots, respectively;

installing an input/output board having an input/output cable onto the subassembly plate;

installing a speaker assembly having a speaker cable and a fan assembly having a fan cable in the orifice of the front subassembly panel;

installing a battery pack having a battery pack cable and a keyboard cable onto the rear subassembly panel, the battery pack cable and the keyboard cable extending through respective orifices in the rear subassembly panel;

attaching the main circuit board assembly to the base system unit; and

removably installing a cover over the base system unit and the main circuit board assembly.

* * * * *

US006307998B2

(12) **United States Patent**
Williams Vigliaturo

(10) **Patent No.: US 6,307,998 B2**
(45) **Date of Patent: Oct. 23, 2001**

(54) **FIBER OPTIC MODULE INCLUDING LENS CAP**

(75) Inventor: **Shari Lynn Williams Vigliaturo**, Excelsior, MN (US)

(73) Assignee: **ADC Telecommunications, Inc.**, Eden Prairie, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/756,441**

(22) Filed: **Jan. 8, 2001**

Related U.S. Application Data

(62) Division of application No. 09/121,066, filed on Jul. 21, 1998, now Pat. No. 6,208,796.

(51) **Int. Cl.**[7] **G02B 6/36**

(52) **U.S. Cl.** **385/134**; 385/78; 385/81; 359/511

(58) **Field of Search** 385/134–136, 385/78, 81; 359/511

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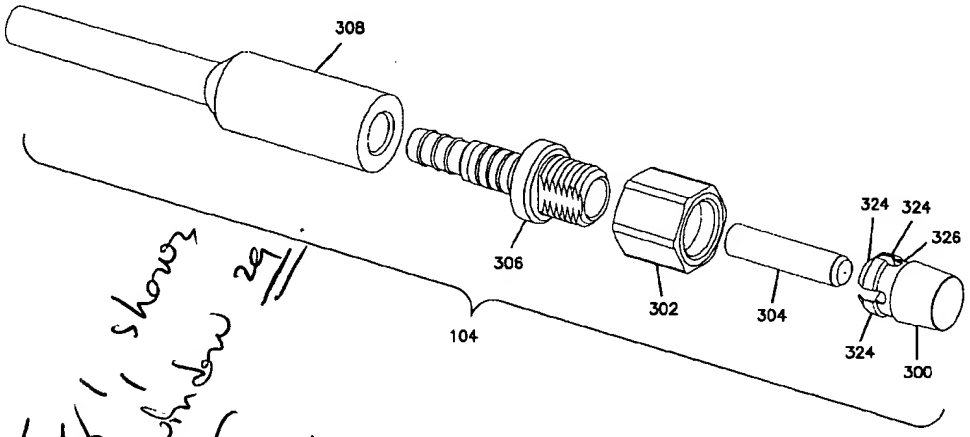
Primary Examiner—Jon Henry
(74) *Attorney, Agent, or Firm*—Merchant & Gould P.C.

(57) **ABSTRACT**

A fiber optic module includes front adapters for connection to fiber optic connectors, and rear adapters for connection to fiber optic connectors. The module includes two circuits having passive optical couplers inside, and adapters exposed along the front and the rear of the module. The module is usable in cross-connect applications with itself or with other modules. The adapters are selectively connectable to fiber optic connectors. The front adapters of the module include two receive input ports and two transmit output ports. The front of the module also includes two visual indicators, one for each circuit. The visual indicators include a lens cap at least partially transparent to visual light in light communication with an optical fiber. The rear adapters of the module include two transmit input ports and two transmit output ports. Monitor ports are also located on the rear for both the transmit and receive signals. The receive monitor ports also function as the input ports for an identification signal sent in the reverse direction for illuminating the visual indicators along the front of the module or another module. Alternatively, separate identification signal input ports can be provided on the front as adapters.

2 Claims, 15 Drawing Sheets



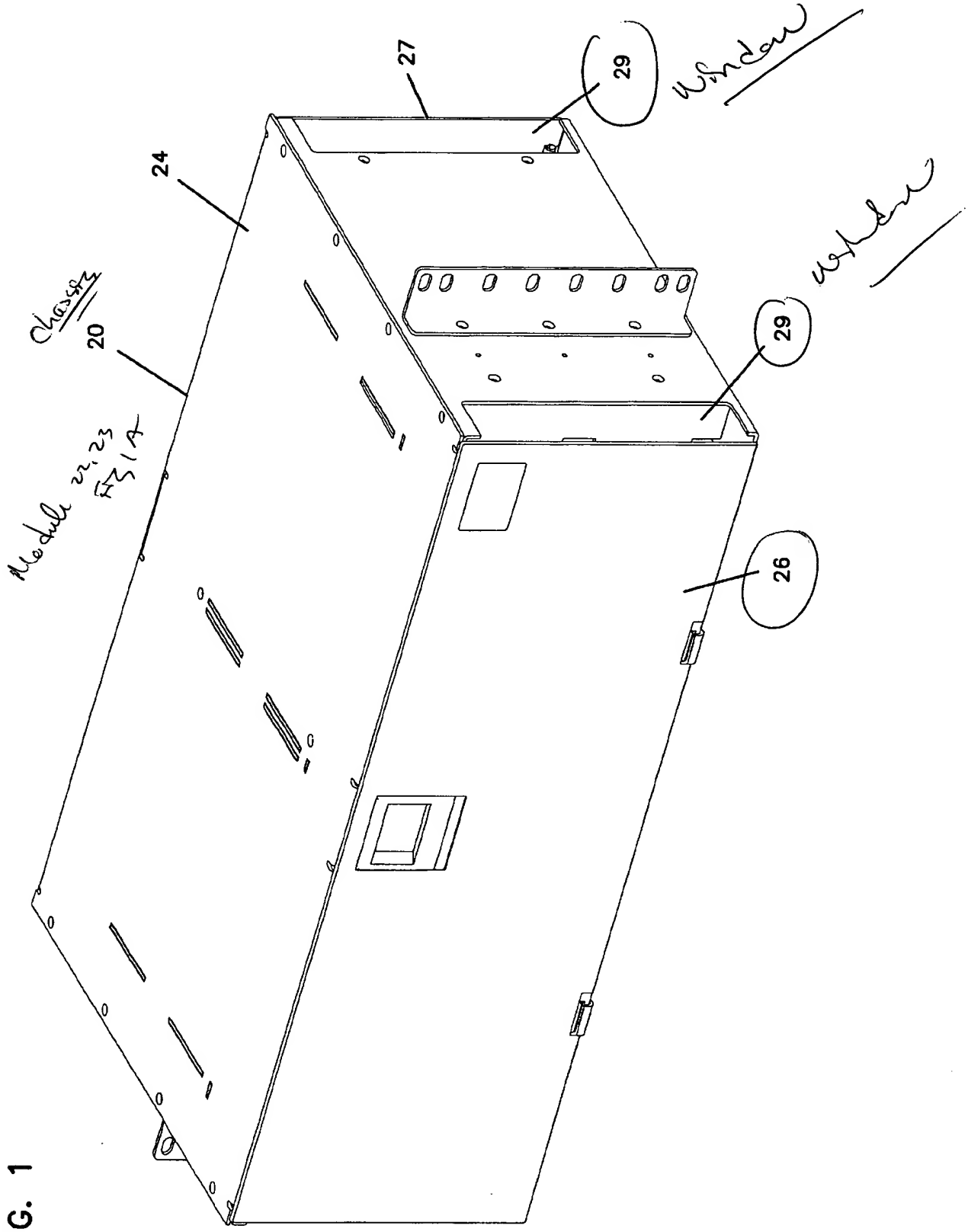


FIG. 1

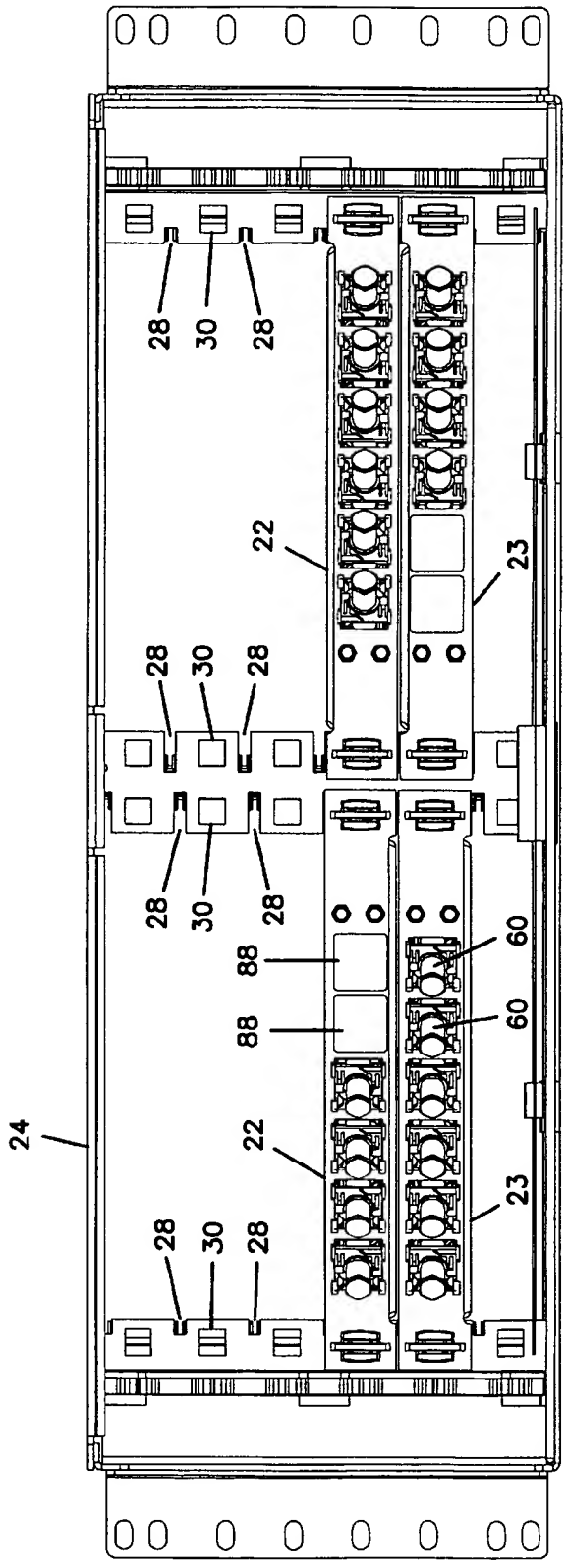


FIG. 1A

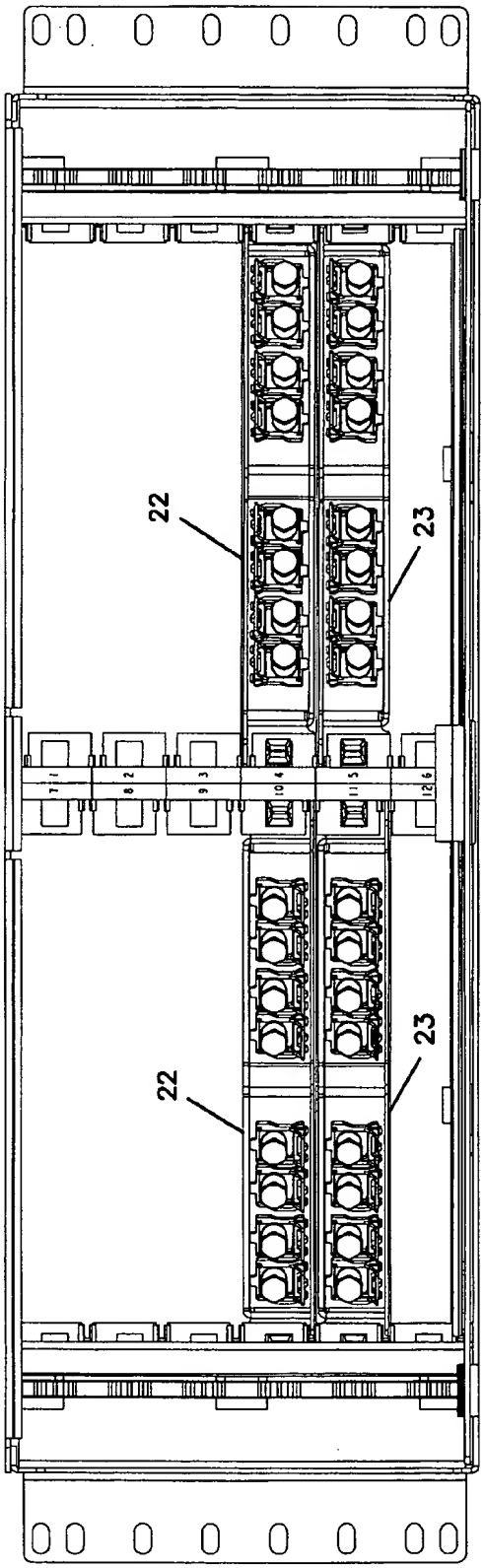
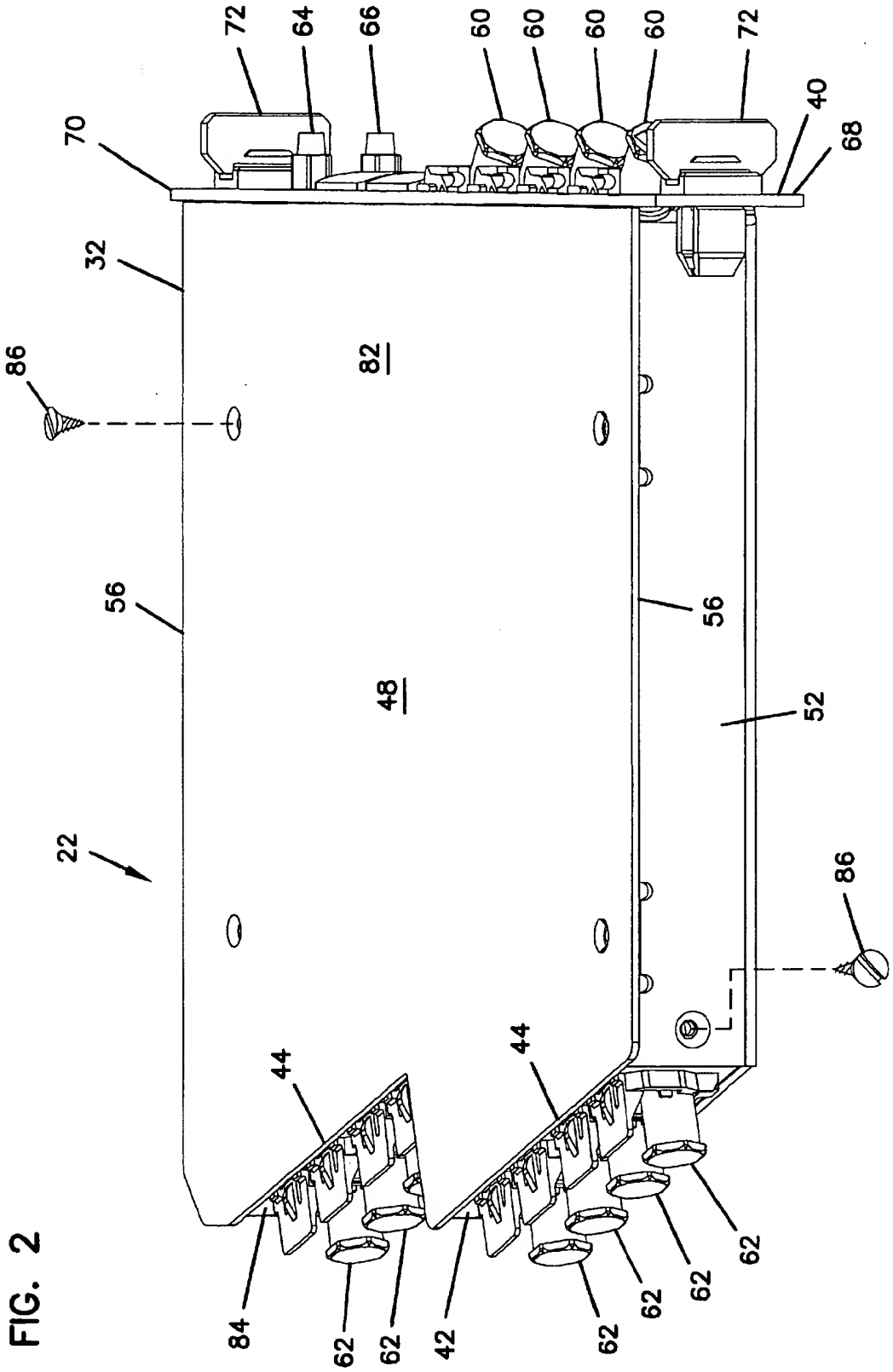


FIG. 1B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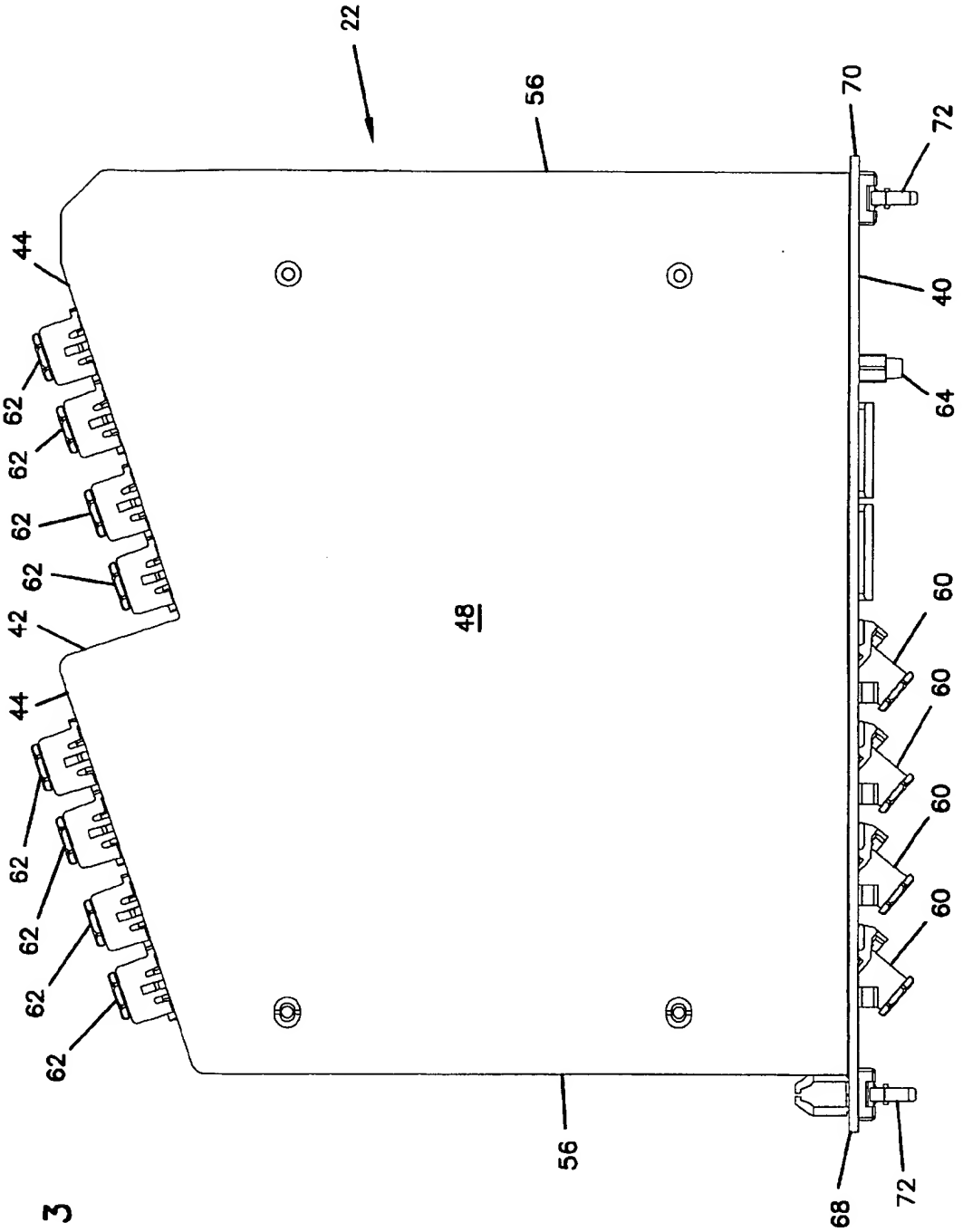
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FIG. 3

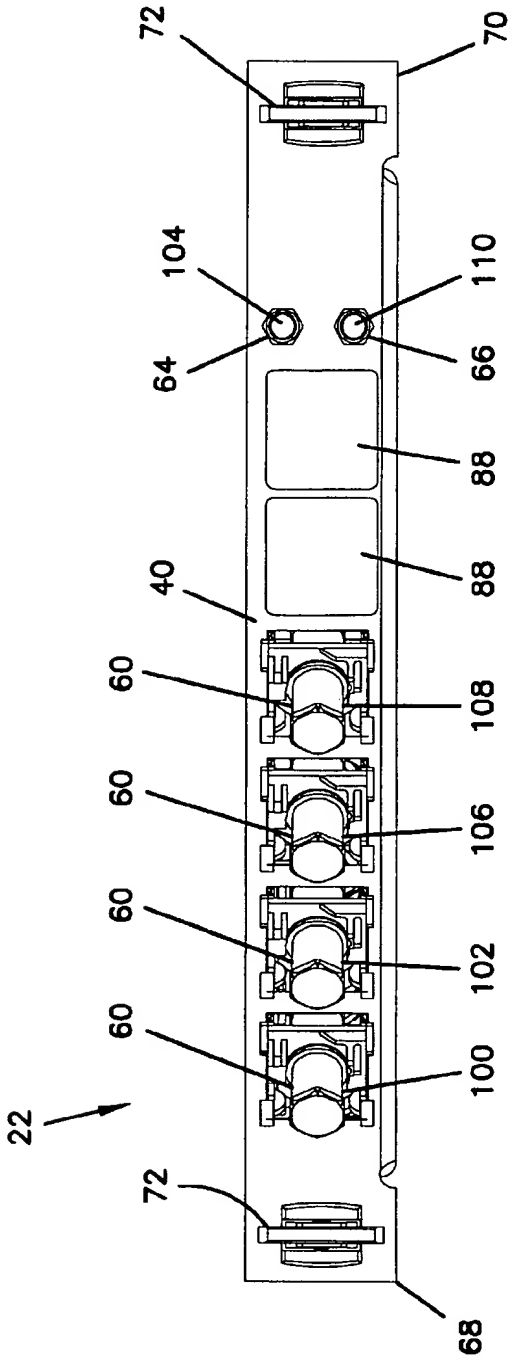
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FIG. 4

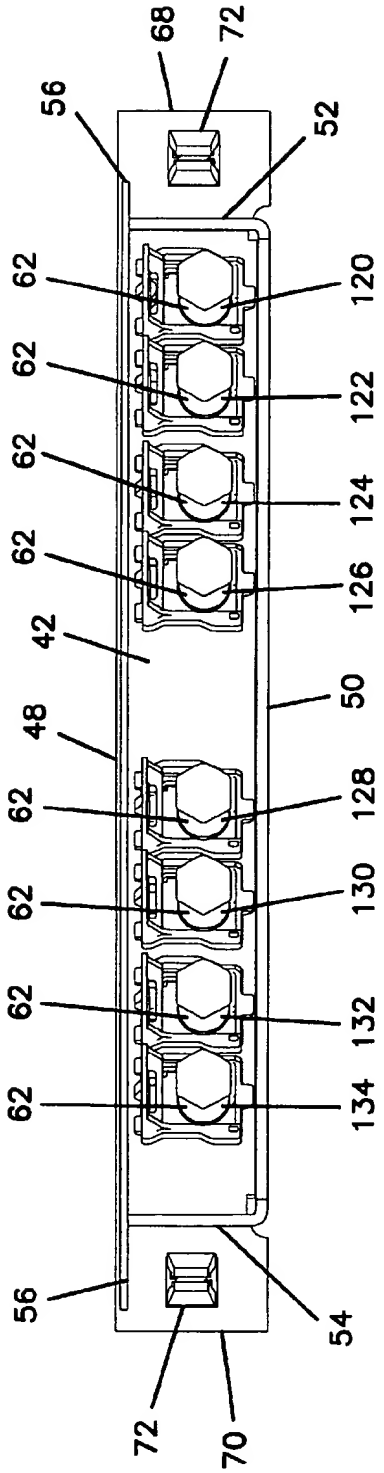
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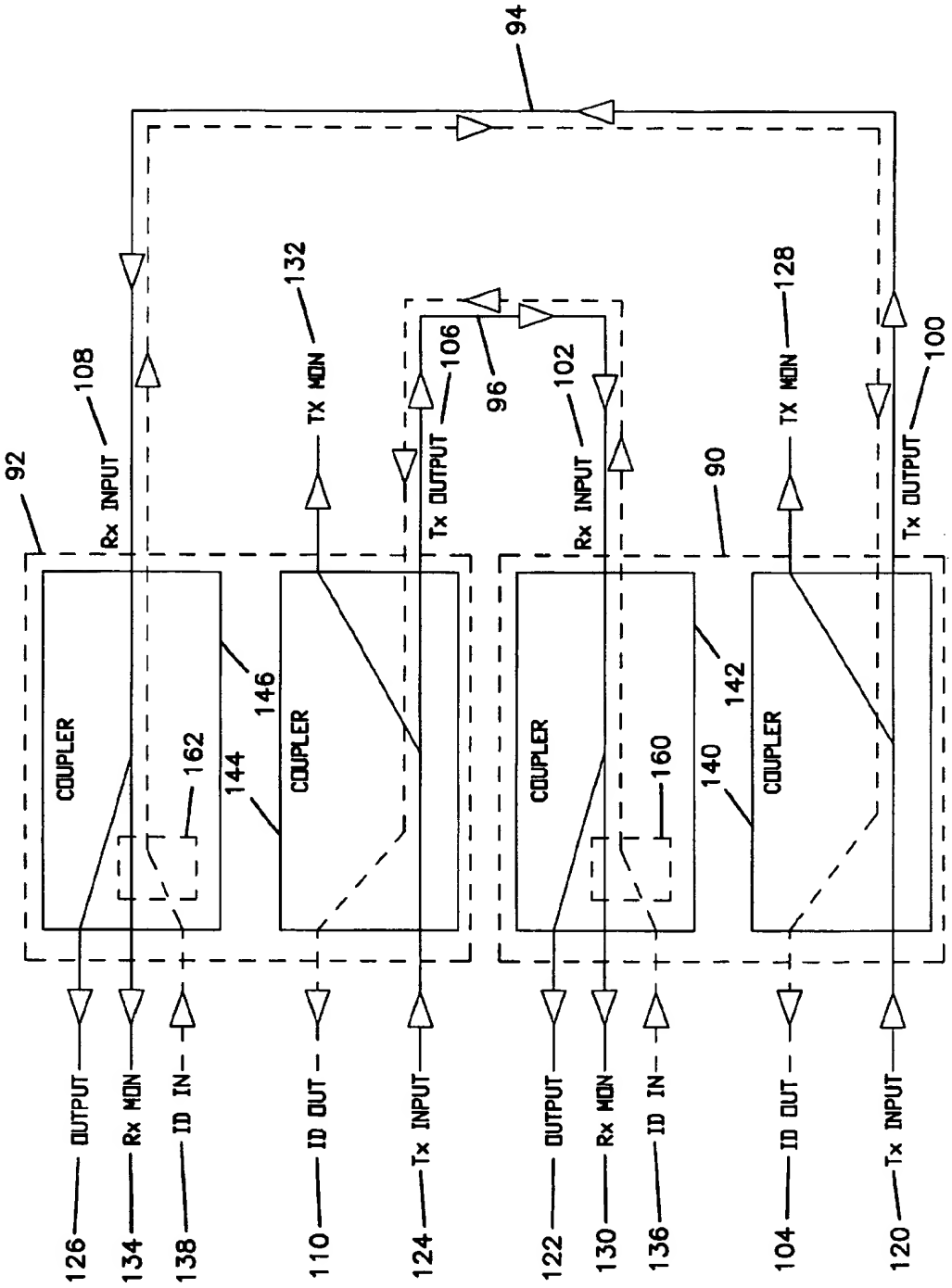
FIG. 5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TX MON
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100
Tx OUTPUT
COUPLER
146
144
162
COUPLER
COUPLER
142
140
160
COUPLER
OUTPUT
Rx MON
ID IN
ID OUT
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OUTPUT
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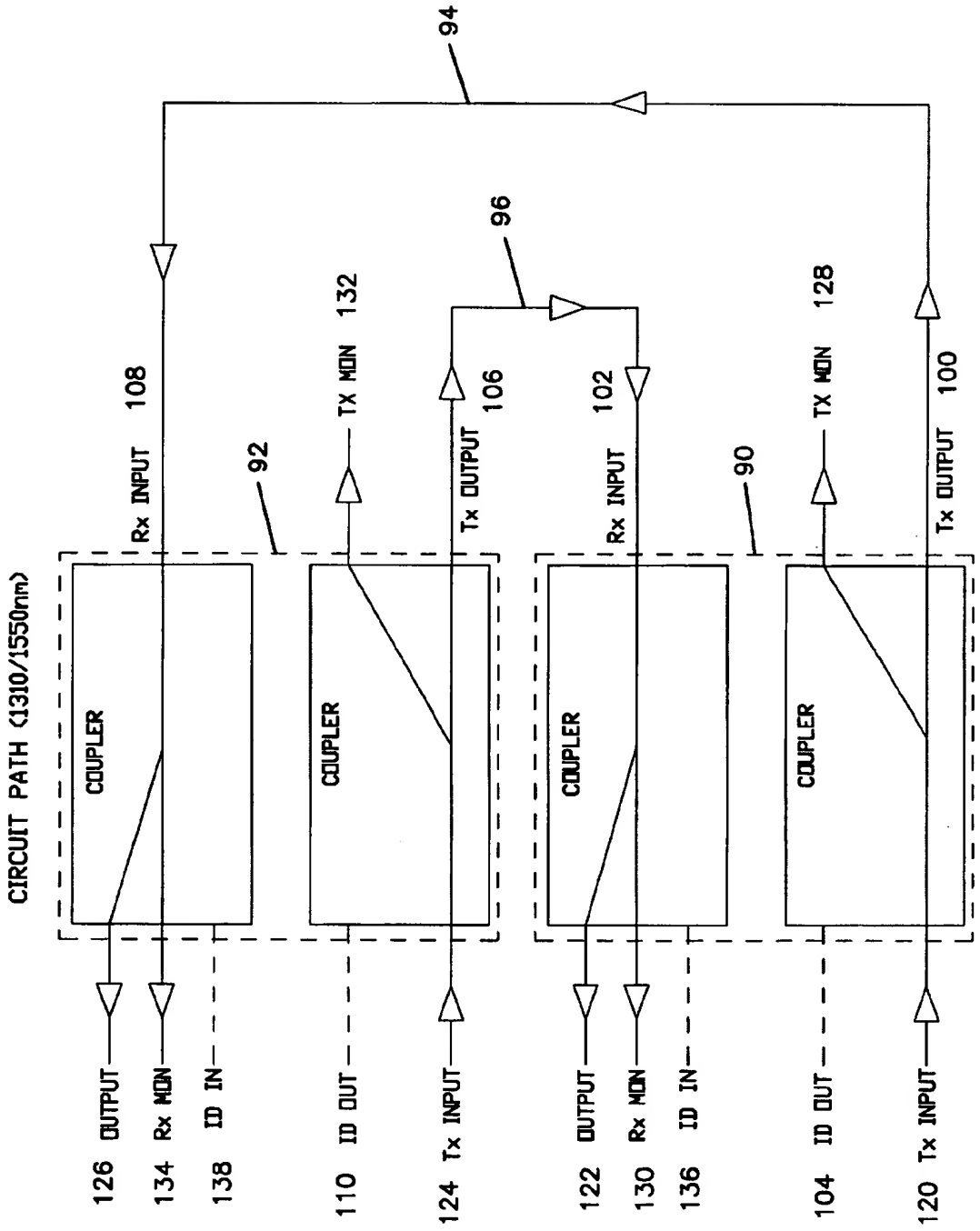
FIG. 6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TX MON
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Tx OUTPUT
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COUPLER
COUPLER
COUPLER
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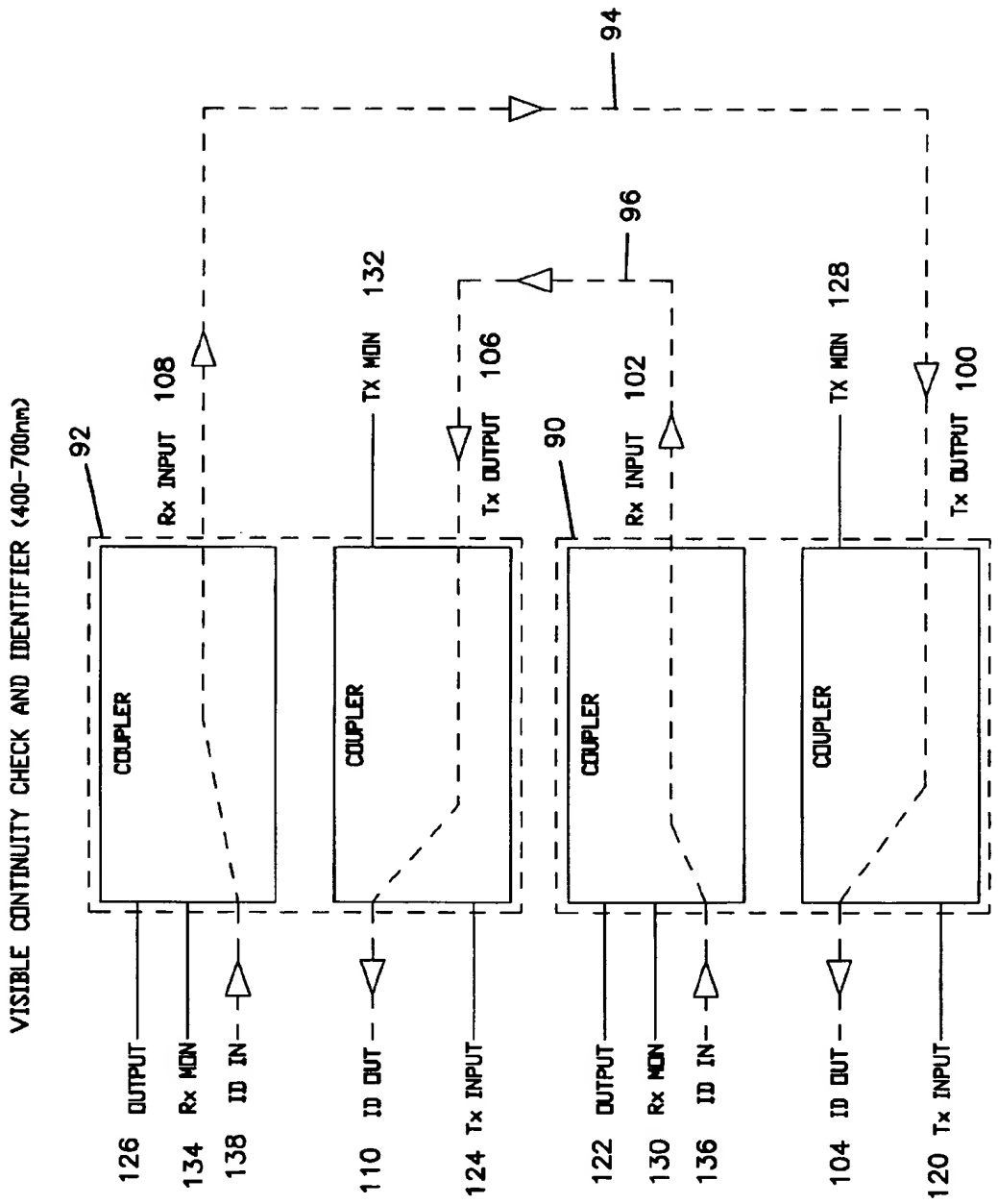
136 ID IN
104 ID OUT
120 Tx INPUT

FIG. 7


VISIBLE CONTINUITY CHECK AND IDENTIFIER (400-700nm)
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90
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96
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Rx INPUT
132
TX MON
106
Tx OUTPUT
102
Rx INPUT
128
TX MON
100
Tx OUTPUT
COUPLER
COUPLER
COUPLER
COUPLER
126 OUTPUT
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110 ID OUT
124 Tx INPUT
122 OUTPUT
130 Rx MON
136 ID IN
104 ID OUT
120 Tx INPUT

FIG. 8

FIG. 9

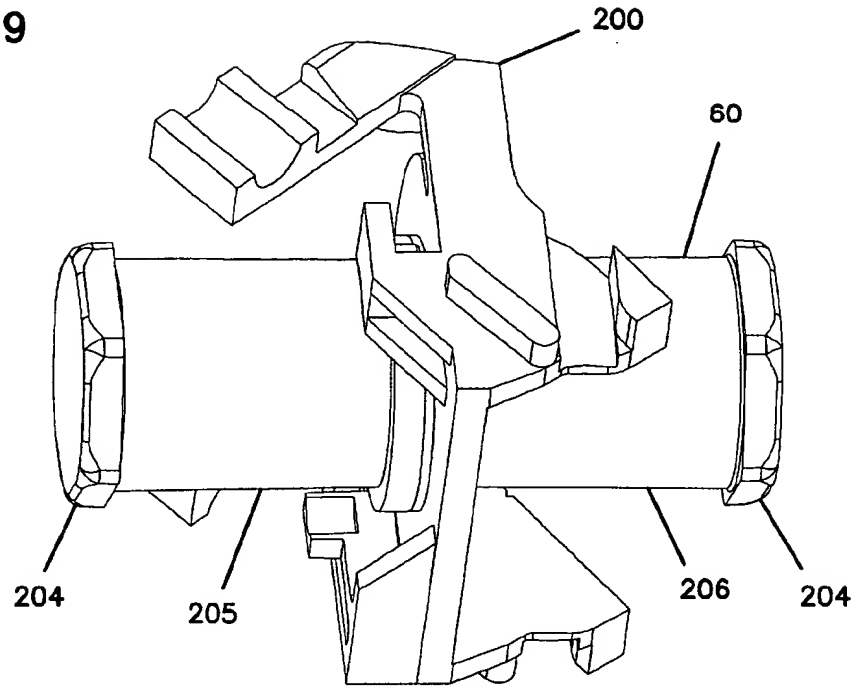
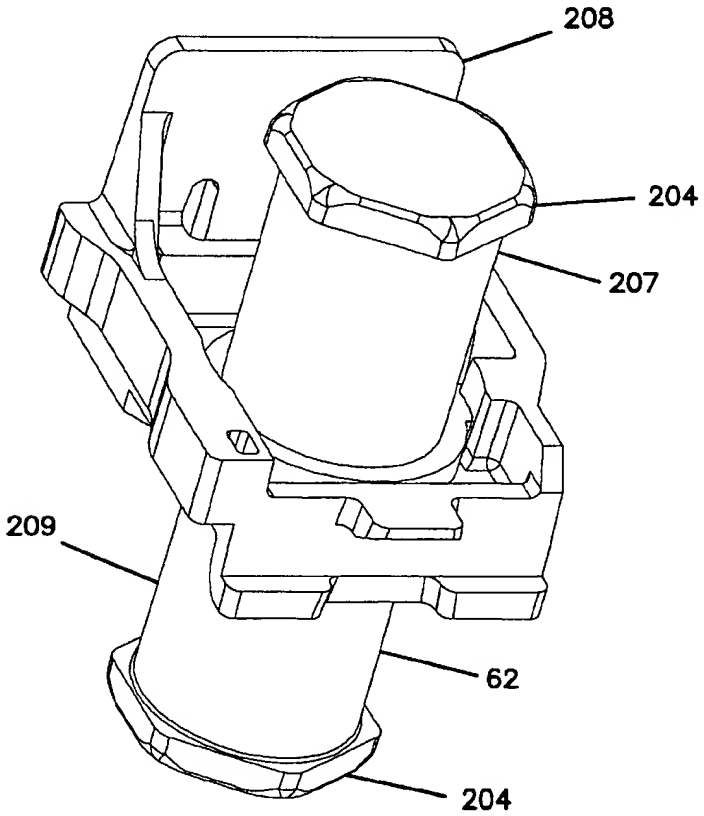


FIG. 10



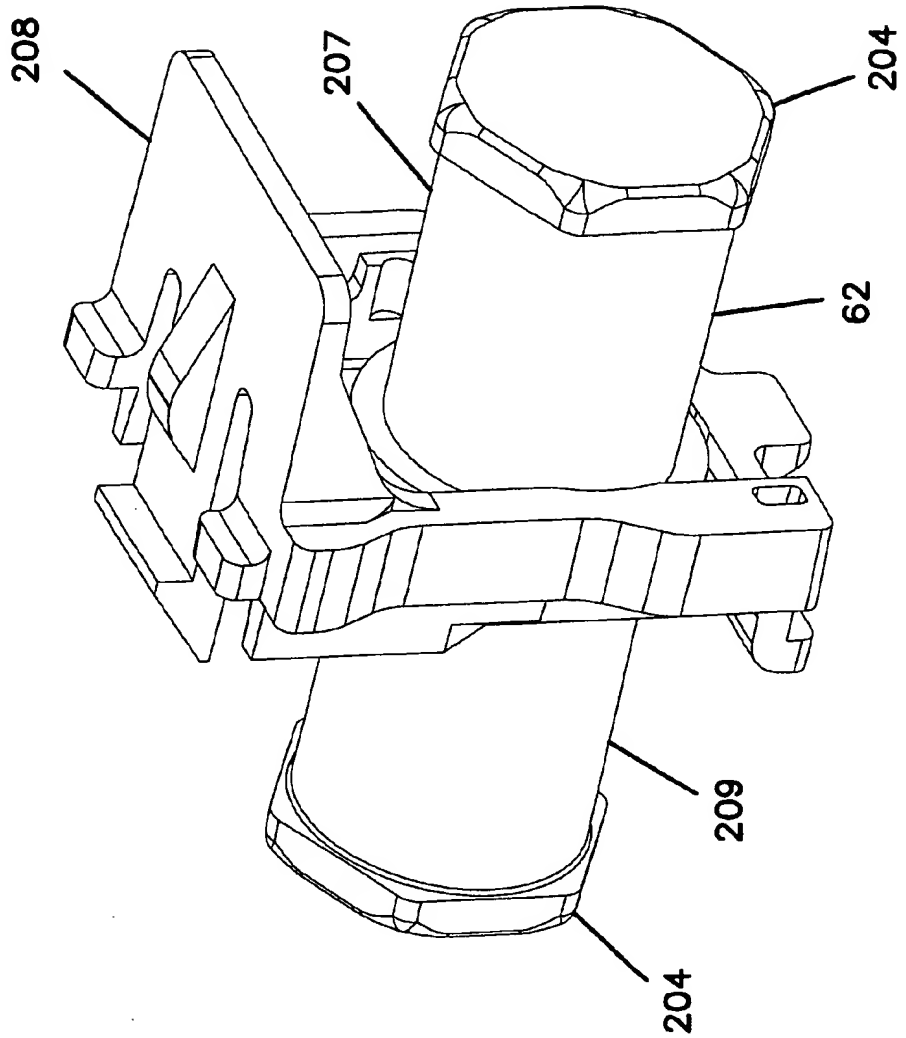


FIG. 11

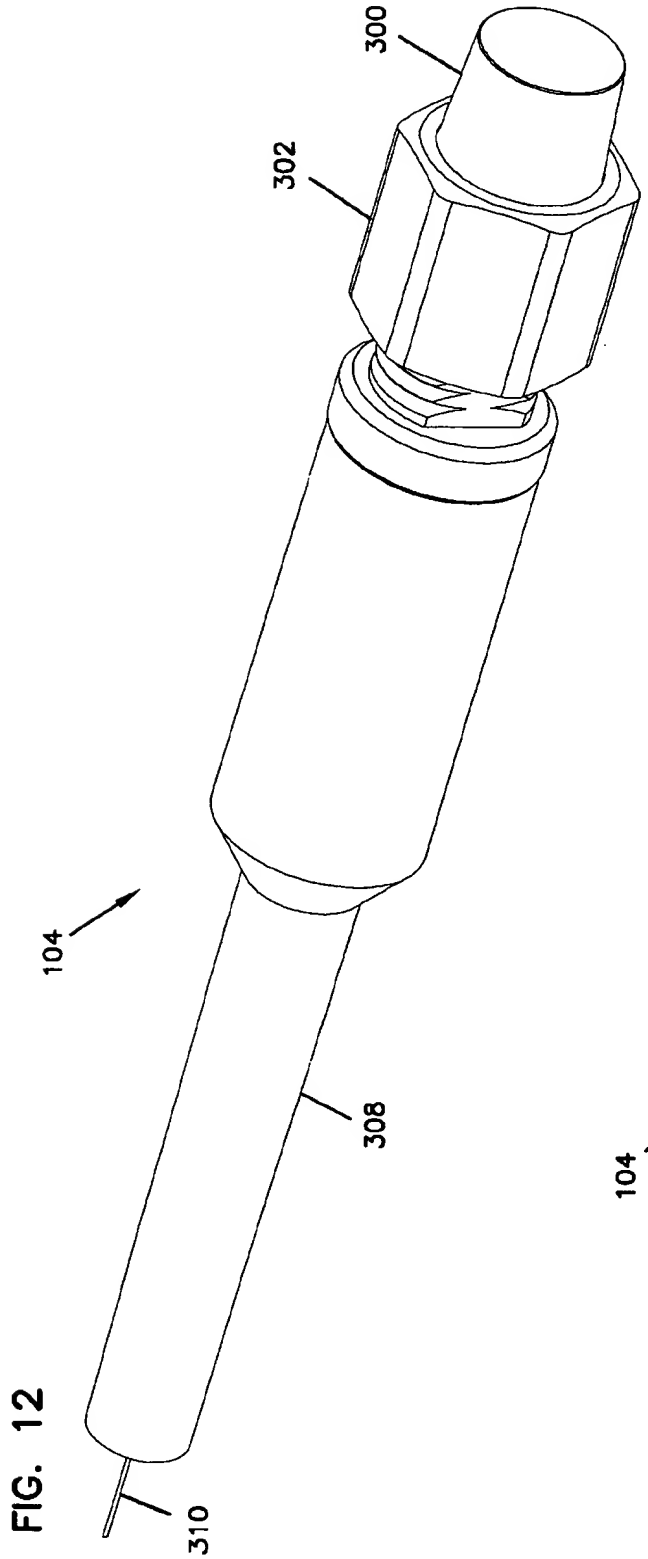


FIG. 12

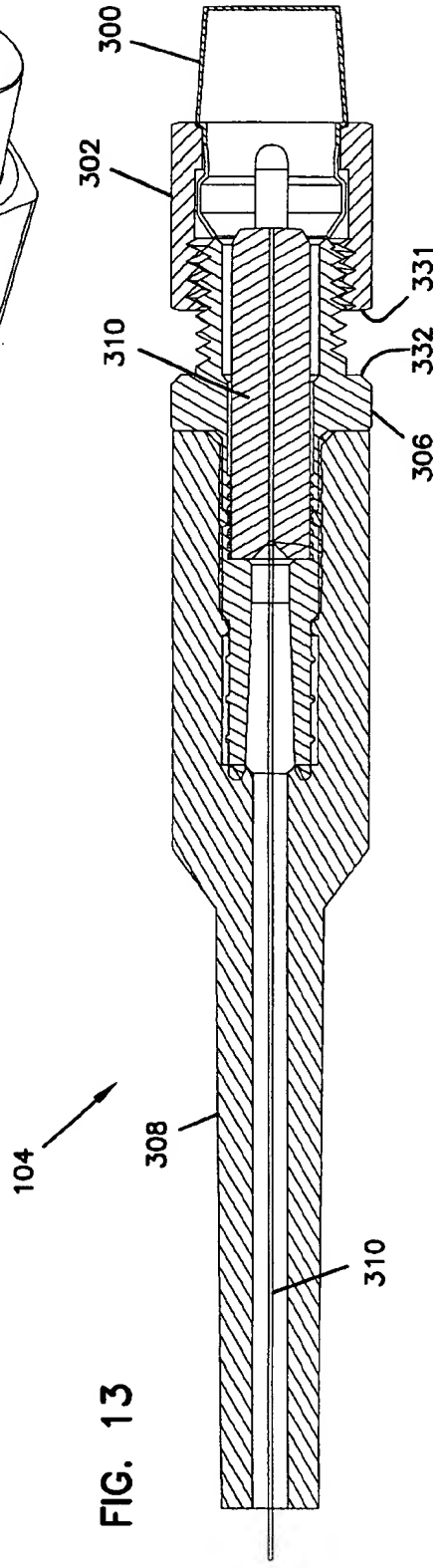


FIG. 13

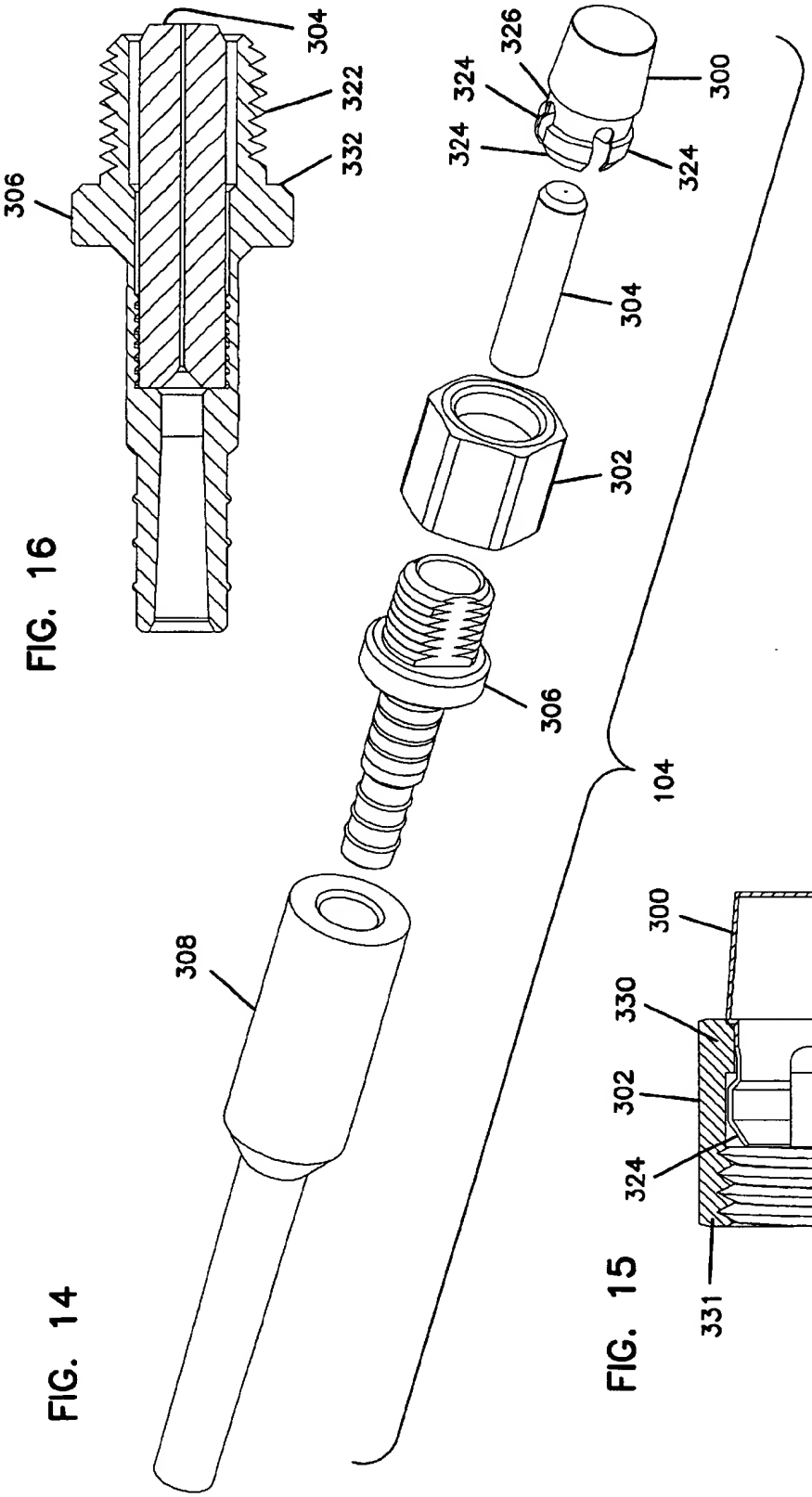


FIG. 16

FIG. 14

FIG. 15

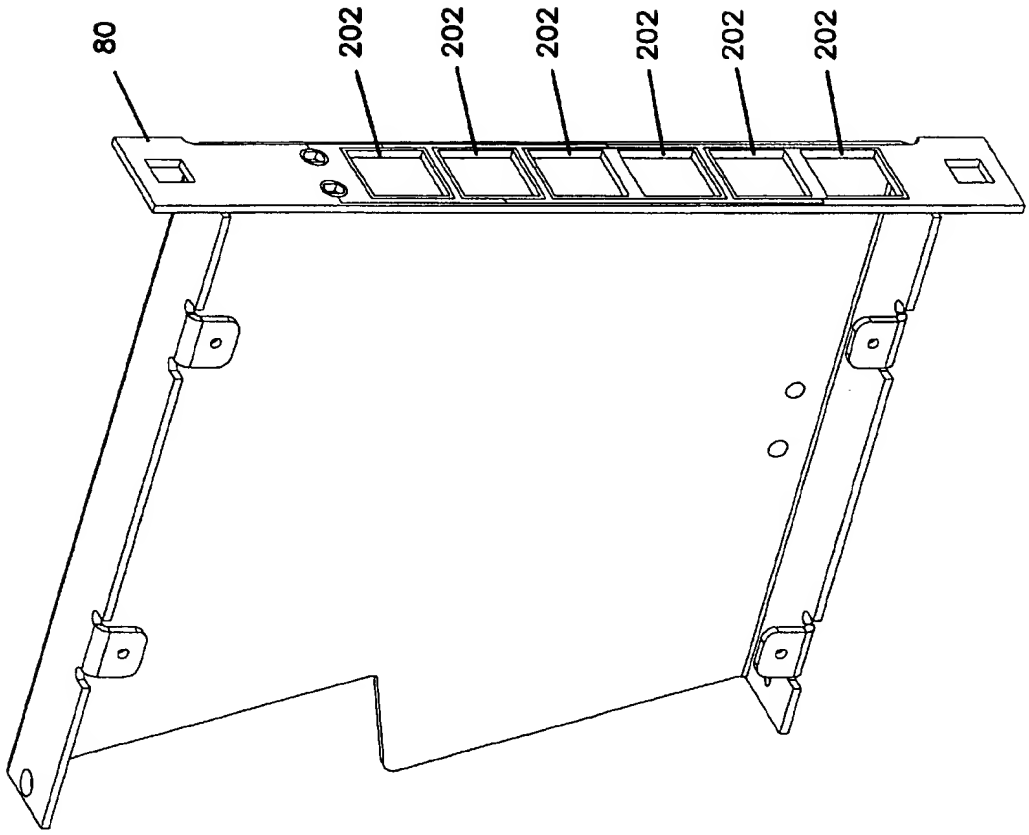
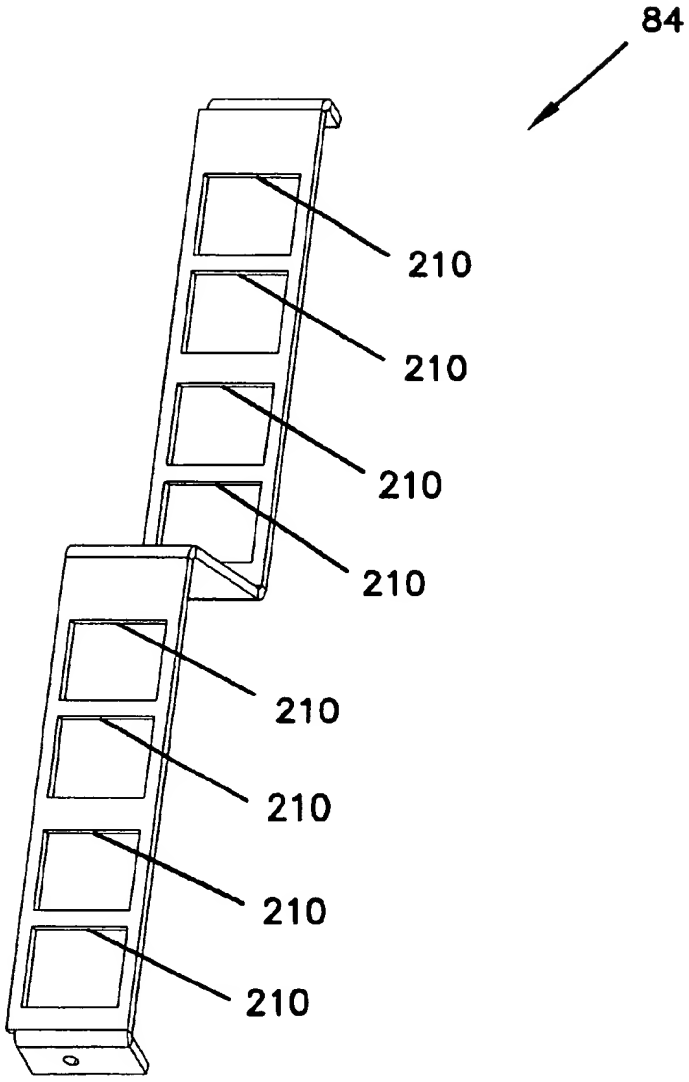


FIG. 17

FIG. 18



FIBER OPTIC MODULE INCLUDING LENS CAP

This application is a divisional of application Ser. No. 09/121,066, filed Jul. 21, 1998, now U.S. Pat. No. 6,208,796 which application(s) are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to fiber optic modules for use in cross-connecting fiber optic equipment.

BACKGROUND OF THE INVENTION

The telecommunications and data transmission industries are rapidly expanding their development of fiber optic transmission systems. Historically, telecommunications signals and data have been transmitted over wire lines such as twisted pair or coaxial cables. In order to accommodate higher signal rate speeds, the industry is turning to increased use of fiber optic cables as the transmission medium.

As the use of fiber optic cables increases, the need for peripheral equipment has increased. For example, it is desirable to have access to a fiber optic line for the purpose of either re-routing the line in the event of damage to the line or to have access to the line for purposes of monitoring or testing the line.

Fiber optic peripheral equipment for cable management, cable storage and connection capabilities are well known. The use of modular fiber optic connector modules is known for performing so-called cross-connect applications. U.S. Pat. Nos. 5,432,875 and 5,363,465 to ADC Telecommunications, Inc. concern fiber optic connector modules and chassis designs for receiving the modules in cross-connect applications.

PCT WO97/41720 also concerns a fiber optic module for use in cross-connect applications. The document discloses optical signal routing, monitoring, and visual path identification capabilities.

There is a continuing need for fiber optic modules which provide optical signal routing, monitoring, and visual path identification capabilities.

SUMMARY OF THE INVENTION

A fiber optic module for mounting to a chassis for holding one or more modules has front and rear access defined by a plurality of connection locations. The connection locations are linked by optical couplers. Two circuits are disposed within the housing of the module. The module is used to cross-connect fiber optic equipment via patch cords on the front connection locations.

In one preferred embodiment, the front of the module includes four adapters for connection to fiber optic connectors, and two visual indicators for visual path identification for the circuits. The front may also include visual signal identification input ports. The rear includes eight adapters for connection to fiber optic connectors.

The rear of the module may include angled linear segments for the connection locations. The front may include adapters in a linear array, each held at an angle to the front of the module by an angled retainer.

The visual indicators may include a lens cap at least partially transparent to visual light connectable to an optical fiber. During injection of an optical signal through the fiber in the visible light range, the lens cap will illuminate.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference letters and numerals indicate corresponding elements throughout the several views:

FIG. **1** shows a perspective view of a chassis including several fiber optic modules mounted within the chassis;

FIG. **1A** is a front view of the chassis with the front door open, and showing two four port fiber optic modules, and two six port fiber optic modules mounted to the chassis;

FIG. **1B** is a rear view of the chassis and modules shown in FIG. **1A** with the rear door open;

FIG. **2** shows a perspective side view of one of the four port fiber optic modules;

FIG. **3** is a top view of the module of FIG. **2**;

FIG. **4** is a front view of the module of FIG. **2**;

FIG. **5** is a rear view of the module of FIG. **2**;

FIG. **6** is a schematic circuit path drawing showing the exemplary signal paths for the main signals (solid) and for the visible continuity check and identifier signals (dashed);

FIG. **7** shows only the circuit paths for the main signals of the circuit drawing of FIG. **6**;

FIG. **8** shows only the circuit paths for the visible continuity check and identifier signals of the drawing of FIG. **6**;

FIG. **9** shows an adapter and retainer of the type along the front of the module;

FIG. **10** shows an adapter and retainer of the type along the rear of the module;

FIG. **11** shows a further view of the adapter and retainer of FIG. **10**;

FIG. **12** is a perspective view of the visual indicator for the signal identifier output device along the front of the module;

FIG. **13** is a cross-sectional side view of the signal identifier output device;

FIG. **14** is a cross-sectional view of the lens cap and the nut of the signal identifier output device;

FIG. **15** is a cross-sectional side view of the sleeve and the ferrule of the signal identifier output device;

FIG. **16** is an exploded view of the signal identifier output device;

FIG. **17** is a perspective view of a portion of the module housing; and

FIG. **18** is a perspective view of a further portion of the module housing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. **1**, **1A** and **1B**, a fiber optic chassis **20** is shown for holding a plurality of the fiber optic modules **22**, **23**. Chassis **20** is mountable to a rack (not shown) for holding chassis **20**. Chassis **20** includes an outer housing **24** and a pivotable front door **26**. Front door **26** allows access to an interior of chassis **20**, so as to access individual modules **22**, **23** such as for repair or replacement of modules **22**, **23** or to connect or disconnect the modules with other modules or fiber optic equipment. Rear door **27** also pivots in a similar manner to allow access to the rear areas of modules **22**, **23**. Housing **24** includes a plurality of guides **28** for holding the individual modules **22**, **23** in a horizontal manner. Side openings **29** allow for cable pathways into and out of chassis **20**.

Modules **22** have four connection locations or ports along the front, and modules **23** have six connection locations or ports along the front. As will be described in greater detail below, modules **22**, **23** are similar in many respects. Both modules **22**, **23** preferably include two circuits for use in cross-connecting fiber optic equipment connected to the

modules at rear connection locations or ports. The modules **22, 23** may also be used for interconnecting fiber optic equipment as desired.

Both modules **22, 23** also allow signal monitoring and visual continuity checks for the circuits. One difference is that to inject an identification signal into one of the circuits, the input port is on the rear for module **22** and on the front for module **23**.

Referring now to FIGS. **2–5**, module **22** has a module housing **32** including a front face **40**, and a generally opposite facing rear face **42**. The front and rear faces **40, 42** each define connection locations **60, 62** for connecting module **22** to fiber optic cables. In the embodiment shown, front face **40** is generally planar, and rear face **42** generally includes at least one angled, linear segment, and preferably two angled, linear segments **44**. The angled segments allow for more connection locations **62** than would be possible with a planar rear face **42** parallel to front face **40**. In the embodiment shown, eight connection locations are defined on rear face **42**, four per segment **44**. In the embodiment shown, the connection locations **60, 62** are both angled relative to front face **40**.

Module **22** further includes opposed major planar sides **48, 50**. Major sides **48, 50** define a top and a bottom in the illustrated embodiment for module **22**. Module **22** further includes opposed minor planar sides **52, 54** defining sides of module **22** in the embodiment shown. Major side **48** has side extensions **56** which form slide rails **56** for receipt in guides **28** of chassis housing **24**. Module **22** is mounted in either orientation as shown in FIGS. **1**, 1A, and 1B. When modules **22** are flipped between the left and right sides, angled connection locations on the front and the rear are directed to respective left and right sides of chassis **20** as shown. Also, module **22** can be mounted vertically if desired.

One construction of module housing **32** is to form front face **40**, major side **50**, and minor sides **52, 54** from a single main piece **80** (see FIG. **17**), such as from sheet metal. A separate cover **82** (see FIG. **2**) and a separate saw tooth-shaped rear piece **84** (see FIGS. 2 and **18**), such as from sheet metal, both attach to single main piece **80** to form the housing for the optical couplers and adapters which permits connection to optical equipment. The attachment of parts can be by fasteners, such as screws.

Module **22** includes a plurality of first adapters **60** exposed along front face **40** for the front connection locations for connection to fiber optic connectors. A plurality of second adapters **62** are positioned along rear face **42** for the rear connection locations, also for connection to fiber optic connectors. The first and second adapters **60, 62** are preferably positioned in linear arrays parallel to front face **40**. The adapters shown are FC type, but could also be SC, ST, or any other suitable connection scheme. The plurality of first adapters **60** are used to cross-connect fiber optic equipment connected to the plurality of rear adapters **62** of module **22**. Alternatively, the equipment may be connected to the rear adapters **62** module **22** and to another module. The two modules are cross-connected to connect the equipment in this situation. Front face **40** of module **22** also includes two visual indicators **64, 66** connected to the optical components within module **22**, as will be described in greater detail below. Alternatively, module **22** can be interconnected to other equipment or another module via front adapters **60**.

Module **22** further includes end flanges **68, 70** for use in mounting module **22** to chassis **20**. Locking members **72** releasably hold flanges **68, 70** to holes **30** of housing **24** of chassis **20**. Locking members **72** are of the type shown and described in U.S. Pat. No. 5,363,465. Locking members **72** operate to lock or release by rotating 90 degrees. Other locking members, including screws may be used as desired.

Front adapters **60** define receive and transmit ports for two passive optical circuits contained within module **22**. In a cross-connect application, rear adapters **62** are connected to fiber optic equipment to be cross-connected at the front adapters **60** through patch cords. The two circuits each allow optical signal routing, monitoring and signal path identification.

Module **22** of one preferred embodiment fits into existing chassis **20** having individual module opening widths of about 7.237 inches, and heights of about 1.100 inches. Holes **30** are positioned about 7.905 inches apart. Module **22** of one preferred embodiment has a length between sides **52, 54** of about 7.11 inches, a length between the outside edges of side extensions **56** of about 7.96 inches, a length between sides **48, 50** of about 1.06 inches, and a length of front face **40** including flanges **68, 70** of about 8.61 inches. Module **22** with two independent circuits has double the density over a module **22** having only a single circuit.

Module **22** includes two plugs **88** which fill unused holes in front face **40** in module **22**. In module **23**, adapters **60** are positioned in front face **40** (see FIG. 1A) where the plugs are in module **22** in a similar manner as the other adapters **60**, for connection to a fiber optic connector.

FIGS. **6–8** illustrate the circuit paths through modules **22, 23** during main signal usage (FIGS. **6** and **7**), and visual continuity check and identifier usage (FIGS. **6** and **8**). Main signals are at the 1310 nanometer (nm) window (for example, 1260–1360 nm) or the 1550 nm window (for example, 1430–1580 nm). During visual continuity checking and identification, the identification signals are passed through the circuits in a reverse direction to the main signals. Further, the identification signals are at a wavelength of visible light, such as 400–700 nm.

Referring now to FIGS. **4** and **6**, along the front of module **22**, two adapters **60** define a first transmit output port **100** and a first receive input port **102** as part of a first circuit **90**. Adapters **60** further define a second transmit output port **106**, and a receive input port **108** as part of a second circuit **92**. A first LED **104** defines first visual indicator **64** and is linked to first circuit **90** for circuit continuity checking and identification. A second LED **110** defines second visual indicator **66** and is linked to second circuit **92** for circuit continuity checking and identification. FIGS. **6–8** are schematics which show the circuit paths during use of module **22** where first circuit **90** is cross-connected to second circuit **92** with patch cords **94, 96**. Each of first and second circuits **90, 92** are also cross-connectable to circuits of other modules. Each of circuits **90, 92** are interconnectable to other modules or equipment.

Adapters **62** define various ports for first and second circuits **90, 92**. Specifically, a first transmit input port **120** and a first receive output port **122** are linked to first circuit front ports **100, 102** through optical couplers within module **22**. Also, a second transmit input port **124** and a second receive output port **126** are linked to second circuit front ports **106, 108** through optical couplers. A first transmit monitor port **128** and a first receive monitor port **130** are part of first circuit **90**, and are positioned along rear face **42**. A second transmit monitor port **132** and a second receive monitor port **134** are part of second circuit **92**, and are also positioned along rear face **42**.

Receive monitor port **130** also is utilized as an identification input port for injecting a signal into first circuit **90** to

trace a circuit path through module **22** to another circuit in module **22** or to another module altogether.

In FIG. **6**, receive monitor port **130** is shown separate from identification input port **136**. This is the case for six port module **23**. For four port module **22**, the two ports **130**, **136** are combined and share the same connector location. This requires an operator to selectively use the combined port as either a monitor or a visual indicator for continuity checking.

Receive monitor port **134** is also utilized as an identification input port for injecting a signal into second circuit **92** to trace a circuit path through module **22** to another circuit in module **22** or to another module altogether.

In FIG. **6**, receive monitor port **134** is shown separate from identification input port **138**. As above for ports **130**, **136**, ports **134**, **138** are separate ports for module **23**. For module **22**, they are the same connection location.

A first optical coupler **140**, such as a two-by-two splitter, links transmit input port **120** to transmit output port **100** and transmit monitor port **128**, each receiving a portion of the signal, such as 50%. A second optical coupler **142**, such as a one-by-two splitter links receive input port **108** to receive output port **126** and receive monitor port **134**, each receiving a portion of the signal, such as 50%. Third and fourth optical couplers **144** and **146** are similarly configured for splitting of the signals from an input port between the respective output and monitor ports. Each of couplers **140**, **142**, **144**, **146** allow the identification signal to pass in the reverse direction to the main signal.

If separate ports are desired for the receive signal monitor function and the identification signal input function, a further optical coupler is provided. In first circuit **90**, a secondary coupler **160**, such as a 1×2 splitter, is provided where monitor port **130** receives about 95% of the signal, and the remaining about 5% is received by the input port **136**. A similar construction is provided for secondary coupler **162** of second circuit **92**. Each of couplers **160**, **162** allow the identification signal to pass in the reverse direction to the main signal.

Referring now to FIG. **9**, adapter **60** is shown in greater detail with a retainer **200** for holding adapter **60** in an opening **202** (see FIG. **18**) of module housing **32**. Retainer **200** holds adapter **60** at a non-perpendicular angle relative to the axis of opening **202**. Retainer **200** snaps into opening **202**. Retainer **200** is also removable, as desired. U.S. Pat. No. 5,214,735 to ADC Telecommunications, Inc. shows and describes an example retainer **200**. Other retainers are possible for mounting adapters **60** to module **22**. Once mounted, end **205** of adapter **60** is exposed for connection to a connector of a fiber optic patch cord, shown schematically in FIGS. **6–8** as cords **94**, **96**.

Referring now to FIGS. **10** and **11**, adapter **62** is shown in greater detail with a retainer **208** for holding adapter **62** in one of the openings **210** along rear face **42** of module housing **32** (see FIG. **18**). Retainer **208** snaps into opening **200**, and is removable as desired. Adapter **62** is shown with protective caps **204**. Other retainers are possible for mounting adapters **62** to module **22**. Once mounted, end **207** is exposed for connection to a connector of a fiber optic cable. As illustrated, adapters **60**, **62** include protective end caps **204**, which are removed prior to connection to a connector. Adapters **60**, **62** also allow connection at opposite ends **206**, **209** to FC type connectors so as to connect easily to the optical couplers within module **22**. Other connector types can be used, as desired.

Referring now to FIGS. **13–16**, first LED **104** is shown in greater detail. Second LED **110** is constructed in a similar manner. Each LED includes a lens portion optically linked to a fiber connected to the main circuits to provide a continuity check for each circuit. A lens cap **300** is held by a nut **302** to an outer sleeve **306**. Lens cap **300** is made from a material at least partially transparent to visible light. An integrally molded lens cap **300** and nut **302** is also possible. An inner ferrule **304** held to outer sleeve **306**, such as adhesive, holds an optical fiber **310** such that an end of the fiber is adjacent to cap **300**. An outer boot **308** provides strain relief for outer sleeve **306**. Nut **302** includes threads **320** which threadably mount to threads **322** of outer sleeve **306**. Cap **300** includes a plurality of flexible legs **324** which enable positioning of a recessed region **326** disposed on an outer surface of cap **300** around a shoulder **330** of nut **302**. Such a construction allows retention of cap **300** with nut **302**. By threading nut **302** to outer sleeve **306**, front face **40** of module housing **32** is trapped between end **331** of nut **302** and shoulder **332** of outer sleeve **306**. When visible light is passed through fiber **310**, the light illuminates lens cap **300** providing a visual indicator to the operator. In an alternative embodiment, lens cap **300** and the remaining components necessary to attach it to a fiber, can be molded from plastic, such as a one-piece molded part.

Having described the present invention in a preferred embodiment, modifications and equivalents may occur to one skilled in the art. It is intended that such modifications and equivalents shall be included within the scope of the claims which are appended hereto.

What is claimed is:

1. A fiber optic continuity indicator device for a fiber optic module including a housing, the device comprising:

a lens cap at least partially transparent to visible light;

a nut mounted to the lens cap;

a sleeve threadably mountable to the nut;

a ferrule for holding an optical fiber, the ferrule mounted to the sleeve;

the nut and the sleeve threadably mountable together to define a space for receipt of a portion of the housing of the fiber optic module.

2. A fiber optic module mountable to a chassis comprising:

a module housing having front and rear faces, opposed major sides, and opposed minor sides defining an enclosed interior, the front face including mounting flanges for mounting the module to the chassis;

a plurality of exposed first adapters along the front face, each of the plurality of first adapters connectable to a fiber optic connector external to the module;

a plurality of exposed second adapters along the rear face, each of the plurality of second adapters connectable to a fiber optic connector external to the module;

wherein the plurality of first and second adapters are optically connected to a fiber optic component disposed in the enclosed interior;

wherein the front face includes a visual indicator optically connected to the fiber optic component, the visual indicator including a lens cap at least partially transparent to visual light.

* * * * *

L Number	Hits	Search Text	DB	Time stamp
1	1944500	module and cabinet and window or hole	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:02
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7	117	module and catch adj basin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:06
8	1	module and catch adj basin and 29/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:08
9	5	module and catch adj basin and chassis	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:09
10	57	catch adj basin and chassis	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:10

11	147	module and tray and window and chassis and pin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:27
12	123	module and tray and housing and window and chassis and pin	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:28
13	175	385/58.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:31
14	1387	385/88.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:31
15	3	385/88.ccls. and module near chassis and window	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:33
16	2	385/134.ccls. and module near chassis and window	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/08/14 08:35
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(19) United States

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(54) TELECOMMUNICATIONS CHASSIS AND MODULE

(76) Inventors: **Brian J. McClellan**, Richfield, MN (US); **Dale C. Madsen**, Jordan, MN (US); **Robin L. Berg JR.**, Shakopee, MN (US); **Joseph S. Czyscon**, Plymouth, MN (US); **Steven W. Skradde**, Lino Lakes, MN (US); **Derek G. Sayres**, Lonsdale, MN (US); **Todd Husom**, Crystal, MN (US)

Correspondence Address:
MERCHANT & GOULD PC
P.O. BOX 2903
MINNEAPOLIS, MN 55402-0903 (US)

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(52) **U.S. Cl.** **385/88**; 385/53; 385/134

(57) **ABSTRACT**

Telecommunications chassis and associated modules for use with the telecommunications chassis are disclosed. Embodiments of the telecommunications chassis include structures such as horizontal channels and/or horizontal surfaces with ridges and/or slots in one surface and slots in ridges of another for receiving edges of modules that mount within the chassis. Other structures of embodiments include divider slots in the horizontal surfaces that receive edges of divider walls to fix the divider walls in place, heat baffle surfaces included within the chassis, and/or cable guides with radius limiters. Module embodiments include structures such as faceplates with angled portions with fiber optic cable connections directed toward the fiber cable's direction of travel. Other module structures include shells that enclose the circuit board and/or provide angled portions with fiber optic cable connections. Module embodiments may also include circuitry for converting electrical signals to optical and optical signals to electrical, and the circuitry may selectively operate at multiple data rates.